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(54) Flexible surgical stapler and handle actuator assembly and firing head assembly suitable therefor.

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Description

Field of the Invention

The invention relates to a flexible surgical stapler, a handle actuator assembly for use with a flexible surgical stapling instrument and a staple firing head assembly adapted for use with a flexible surgical stapling instrument.

Background of the Invention

The field of surgical stapling has grown since its inception in the 1960's. During this time of growth, basically four different types of stapling instruments have developed. One type of stapling instrument is a skin stapling instrument used to close wounds on the skin. A second type of stapling instrument is a surgical stapling instrument which is used for inverted linear anastomosis or gastrointestinal anastomosis. Such instrument is designed to provide a side by side connection of two lumens of organs. Such instruments generally include two double rows of staples with a cutting blade between the double rows.

Another common surgical instrument is a thoracic abdominal instrument which produces a linear suture line with a double staggered row of staples. Such an instrument generally consists of a C-shaped frame. A disposable anvil for forming the staples adapts to a fixed outer limb of the C of the instrument, and a disposable staple cartridge adapts to a corresponding inner limb of the C-shaped instrument.

Another surgical stapling instrument is an end to end anastomosis surgical stapling instrument. In such an instrument, the lumen of an organ is rejoined, such as, for example, two bowel segments are joined end to end. Such an instrument generally provides a double row of staples and a cutting blade. The double row of staples provide the means for connecting the lumens end to end while the cutting blade removes that portion of the organ extending inwardly of the lumen at the connection site.

In the surgical stapling instruments, there is a staple firing head and a handle assembly for firing the staples. Currently, such instruments include a mechanical linkage between the handle actuator and the staple firing head in order to fire the staples. In use, it is often difficult to position a stapling instrument in order to ensure a proper and acceptable connection or joining of the tissue. This is often due to the differing locations where the stapling instrument is being used and where the joining of tissue is occurring. It would be desirable to provide stapling instruments which would have a stapling firing head assembly which could be readily positioned at the tissue site to be joined and which would provide flexibility between such stapling firing head and the handle actuator assembly. Such flexibility would also be desirable on an end to end anastomosis instrument as it would allow insertion of the staple firing head or flexible connector through tortuous passages of an organ such as the sigmoid colon.

EP-A-0 095 970 discloses a flexible surgical stapler assembly comprising: a staple firing head assembly comprising an anvil, a housing for carrying an array of staples and a pusher for exerting a force on the staples in the housing to eject the staples from the housing and form the staples against the anvil; and a handler actuator assembly comprising a housing, a flexible band carrier slidable within the housing, a flexible band being connected at one of its ends to the carrier and at the other of its ends to the anvil of the staple firing head assembly, and handles on the housing operatively connected to the carrier for moving the carrier and concomitantly ejecting the staples from the housing and forming the staples against the anvil.

WO-A-82/00968 discloses a surgical stapling instrument including an actuator assembly. The actuator assembly includes a housing. A tubular portion extends forwardly from the housing. A staple cartridge is mounted on the forward end of the tubular portion. A tubular actuating member is accommodated in the tubular portion and cooperates with the cartridge. A rod is fixed to the housing, extends through the tubular portion and carries at its forward end an anvil. A handle is pivotally mounted on the housing and is connected by a link to a toggle mechanism interconnecting the rod and the housing. Pivoting of the handle towards the housing causes the toggle mechanism to drive the actuating member in a direction away from the housing thereby ejecting staples from the cartridge against the anvil.

The present invention provides a flexible surgical stapler assembly, which has a cable connecting a staple firing head assembly with a handle actuator assembly and as compared with the known flexible surgical stapler referred to above operates in a different way.

Summary of the Invention

In accordance with a first aspect of the present invention, there is provided a flexible surgical stapler for applying an array of staples to tissue, the stapler comprising:

a staple firing head assembly comprising:

an anvil assembly means having an anvil surface

with an array of staple forming depressions therein;
a staple housing means for carrying the array of staples; and
a staple pusher means for exerting a force on the staples in the staple housing means to eject the staples from the staple housing means and form the staples against the anvil surface;
a handle actuator assembly comprising:
a housing defining an inner cavity therein;
a cable carrier slidable within the cavity;
a length of flexible cable connected at one of its ends to the cable carrier and at its other end to the anvil assembly means of the staple firing head assembly; and
a handle means on the housing selectively operatively connected to the cable carrier for moving the cable carrier and concomitantly forcing the staples out of the staple housing means and forming the staples against the anvil surface; and
static means extending between the handle actuator assembly and staple firing head assembly for maintaining the staple pusher means in a fixed position with regard to movement toward the handle actuator assembly along the length of flexible cable;
the anvil assembly means being movable by the cable from an open position, wherein the anvil surface is substantially spaced from the staple housing means, to a tissue approximation position, wherein the anvil surface is closely spaced from the staple housing means for approximating tissue, the anvil assembly means and staple housing means being co-operatively movable by the cable with respect to the staple pusher means toward the handle actuator assembly from the tissue approximation position to a firing position, wherein the staples are forced from the staple housing means against the anvil surface by the staple pusher means.

In accordance with a second aspect of the invention, there is provided a handle actuator assembly for use with a flexible surgical stapling instrument, the handle actuator assembly comprising:
a housing defining an inner cavity therein;
a cable carrier movable within the cavity including cable connection means for connecting the cable carrier means to a length of flexible cable;
a pin extending from the cable carrier;
a first lever arm pivotally attached to the housing;
a second lever arm pivotally attached to the first lever arm and a slot on the second lever arm whereby the second lever arm is cooperatively attachable through the slot to the extending pin of the cable carrier; and
tissue approximation means on the housing operatively connected to the cable carrier for selectively adjusting the position of the cable carrier within the cavity; and slidable ramp means in the housing cooperatively engageable with the lever arm to engage the slot on the second lever arm with the extending pin on the cable carrier.

In accordance with a third aspect of the invention there is provided a staple firing head assembly adapted for use with a flexible surgical stapling instrument, the staple firing head assembly comprising:
a staple cartridge receving means for receiving a cartridge carrying an array of staples and staple drivers for such staples;
an anvil shaft on the anvil assembly means; and
staple pusher means comprising a forwardly extending head or end for contacting the staple drivers to force the staple drivers against the staples in the cartridge thereby forcing the staples against the staple forming depressions on the anvil surface as the staple cartridge receiving means, the anvil assembly means, and the anvil shaft move rearwardly toward the staple pusher means.

A feature of the flexible surgical stapler assembly herein is that the handle actuator assembly can be used with a variety of staple firing head assemblies. That is, for example, the handle actuator assembly of the flexible surgical stapler assembly herein can be used with a thoracic abdominal staple firing head assembly and with an end to end anastomosis head assembly.

The flexible stapler instrument herein provides benefits in that the assembly can be adapted for use with varying staple firing head assemblies as discussed above. In addition, the flexible stapling instrument assembly herein provides adaptability for use in stapling various tissues as the staple firing head assembly can be readily positioned due to the flexible spine linking the staple firing head assembly. The flexible surgical stapling instrument herein provides an instrument which basically has a single moving cable that pulls the anvil toward the staples and subsequently pulls the staple cartridge assembly past the staples which are held in a fixed position. The staples then encounter the approaching anvil surface and its corresponding grooves which, as it continues to move toward the staples, forms the staples through the tissue clamped between the anvil surface and the staple cartridge.

The flexible stapler instrument herein also provides a surgical stapling assembly which can be provided in component parts. That is, the flexible stapler instrument herein can be constructed such that the handle actuator assembly can be constructed of reusable materials to provide a reusability for the handle actuator assembly. The staple firing head assembly and the flexible spine assembly can be constructed of materials that make such assemblies disposable. The staple firing head assembly and flexible spine assembly can be con-

structed of plastic or include some plastic parts, or can be constructed rather inexpensively to provide disposability. It is an advantage of the overall assembly that the staple firing head assembly and flexible spine assembly can be disposable. The staple firing head assembly and flexible spine assembly comprise the two components of the overall assembly herein which are inserted into the body of the patient. By constructing these two assemblies such that they are disposable, the inherent problems associated with reusing surgical instruments can be avoided. Namely the problems of cross-contamination, sterilization, and associated staff time to disassemble, sterilize, and reassemble can be avoided. Another problem that is avoided by making the staple firing head and flexible spine assembly disposable or for use on individual patients is that cable stretch over time is avoided. Cable stretch can occur when the same cable is used repeatedly.

Another feature of the present invention is the ability to provide a handle actuator assembly which can be used with a variety of staple firing head assemblies and flexible spine assemblies. Such a feature is desirable as different lengths of flexible spine assemblies can be used and fitted to the handle actuator assembly. That is, if a particular procedure calls for a particular length of flexible spine assembly, then a staple firing head assembly having the appropriate length of flexible spine assembly can be interconnected to a reusable handle actuator assembly. The flexible stapler instrument assembly herein is advantageous in that it can be used to reduce hospital costs in that the handle actuator assembly can be reusable and the staple firing head assembly and flexible spine assembly can be disposable. In addition, the handle actuator assembly can be used with a variety of staple firing heads such as those shown in the accompanying drawings, depending upon the type of staple pattern to be used.

Brief Description of the Drawings

The particular advantages and details of the present invention will become more evident from a consideration of the following detailed description when reviewed in combination with the appended drawings wherein:

FIGURE 1 is a side elevation view partially in cross section of an embodiment of a handle actuator assembly for a flexible surgical stapling assembly herein;

FIGURE 2 is a side elevational view partially in cross section of a preferred embodiment of a handle actuator assembly for use in the flexible surgical stapling assembly herein;

FIGURE 3 is a side elevational view partially in cross section of an embodiment of a staple firing head assembly for use in end to end anastomosis:

FIGURE 3A is an end view of the staple firing head assembly taken along 3A of FIGURE 3;

FIGURE 4 is a side elevational view partially in cross section of an embodiment of an end to end anastomosis flexible stapling instrument assembly herein illustrating the location of the actuation elements in the assembly prior to use;

FIGURE 5 is a side elevational view partially in cross section of the assembly in FIGURE 4 illustrating the assembly during the approximation of tissue between the anvil and staple housing;

FIGURE 6 is a side elevational view partially in cross section of the staple firing head assembly of FIGURE 4 showing the approximation of a thicker tissue in the staple firing head assembly;

FIGURE 7 is a side elevational view partially in cross section illustrating the assembly shown in FIGURE 4 upon firing of the staples therein;

FIGURE 8 is a side elevational view partially in cross section of a staple firing head assembly for use in providing linear extending staples;

FIGURE 9 is a side elevational view partially in cross section of the staple firing head assembly shown in FIGURE 8 illustrating the approximation of tissue between the anvil and staple housing; and

FIGURE 10 is another side elevational view partially in cross section of the staple firing head assembly of FIGURE 8 showing the head assembly as the staples have been fired from such head assembly.

Detailed Description

The flexible surgical stapler instrument assembly herein will be described with regard to the accompanying drawings. In particular, FIGURES 1 and 2 illustrate two working embodiments of a handle actuator assembly. FIGURE 3 illustrates a stapling head assembly for use in end to end anastomosis and FIGURES 4-7 schematically represent the operation of such an end to end anastomosis flexible stapling instrument assembly. The remaining FIGURES 8-10 represent a linear stapling head assembly and its operation.

The flexible stapler instrument assembly herein is beat illustrated with regard to FIGURE 4 which shows the flexible stapler instrument assembly 10. The flexible stapler instrument assembly includes three sections, namely, a handle actuator assembly 12, a stapling head assembly 14, and a flexible spine assembly 16 interconnecting the handle ac-

tuator assembly and stapling head assembly.

In order to facilitate the description of the assembly herein, the description will first be directed to the handle actuator assembly and, in particular, to a handle actuator assembly 13 shown in FIGURE 1. The handle actuator assembly therein includes a housing 18 which can be constructed of any suitable material and have any geometric configuration. For example, the housing can be a generally tubular housing having a length greater than its width and can be either cylindrical or multisided tubular. The housing can be constructed of any suitable material, and acceptable materials include stainless steel and various medical grade plastics. The handle assembly can be constructed of metal to provide a reusable handle assembly and can be constructed of plastics to provide a disposable handle assembly. When the handle actuator assembly is constructed so as to be disposable, the entire flexible stapling instrument assembly can also be constructed so as to be disposable.

The housing 18 includes a rear spacer 20 and a front spacer 22 which combine with the housing to define a cavity 30 within the housing. A cable carrier 28 is positioned within the cavity. The cable carrier is freely slidable within the cavity of the housing.

A cable 24 extends through and from the front spacer 22. The cable 24 can be any suitable cable and is preferably a multi-stranded steel wire cable. The cable is attached at one of its ends to the cable carrier 28.

The cable carrier is freely slidable within the cavity 30 of the housing. The cable carrier can move between the end wall 32 of the front spacer and the end wall 34 of the rear spacer. The cable carrier is keyed to the housing to prevent rotation and to define a race in which the cable carrier can slide. The length of movement of the cable carrier depends upon the stapling head assembly attached at the other end of the cable. The cable carrier 28 includes a cavity or recess 36. The recess 36 is adapted to receive a connecting rod 38 which is interconnected to a threaded shaft 41. The recess 36 can be enclosed by a plate 37 which can be joined to the cable carrier by suitable bolts 39.

The threaded shaft 41 is part of a gap adjustment assembly 40 which is keyed to the housing or the rear spacer of the housing. The gap adjustment assembly permits the approximation of the tissue to be stapled between the anvil surface and the staple housing prior to the firing of the staples. The gap adjustment assembly includes the threaded shaft 41 which is adapted to move longitudinally within the housing. The threaded shaft 41 has an outer threaded surface 46 which engages a threaded surface 44 on an inner surface of a rotatable knob 42. The rotatable knob 42 rotates within the housing but does not move in or out of the housing, that is, does not move its position relative to the housing except for rotation. The threaded shaft 41 is keyed to the housing along the same key as the cable carrier such that the threaded shaft does not rotate. The threaded shaft can be prevented from rotating by a radial protrusion 43 through which the threaded shaft can move or which can move concomitantly with the threaded shaft in the cavity 30. Since the threaded shaft 41 does not rotate, it moves inwardly and outwardly of the housing as the rotatable knob 42 is rotated. The threads on the rotatable knob interlock with the threads on the threaded shaft and, upon rotation of the knob, move the threaded shaft. Concomitantly with the movement of the threaded shaft, the cable carrier 28 moves due to the attachment of the cable carrier to the threaded shaft through the connecting rod 38. The function of the rotatable knob and threaded shaft 41 will hereinafter be described with regard to the description of the stapling head assembly and overall operation of the instrument.

Also on the housing 18 is a lever assembly 52. The lever assembly provides a trigger mechanism for firing the staples and forming the staples. The lever assembly 52 includes a lever 54 which is pivotally attached to the housing through a pivot pin 56. The lever 54 is also pivotally attached to an arm 58 through a second pivot pin 60. A first torsion spring 62 can bias the lever 54 against the arm 58 and can wrap around the second pivot pin 60 and a second torsion spring 63 can bias the lever 54 against the housing and can wrap around the first pivot pin 56. The second pivot pin 60 provides a pivotal linkage which, upon movement of the lever 54 toward the housing, causes the arm 58 to move toward the rotatable knob or rearward end of the housing.

The cable carrier 28 is provided with an outwardly extending pin 48. The outwardly extending pin 48 is designed to engage a corresponding slot 50 on the arm 58. As can be seen in FIGURE 1, the arm 53 is initially not engaged with the pin 48 on the cable carrier. Such an arrangement provides for movement of the cable carrier without moving the triggering mechanism in the lever assembly 52.

To engage the slot 50 of the arm 58 with the pin 48 on the cable carrier, a ramp 64 is provided in the cavity 30 of the housing. The ramp 64 is freely slidable within the cavity. The ramp has a leading end which includes a sloped surface 66 which engages the slotted end of the arm 58 and moves such slotted end toward the pin 48 on the cable carrier. The ramp 64 includes an extending pin 68 which extends outwardly from the cavity and projects through a slot 70 on the housing. The extending pin 68 provides the ability to manually

move the ramp from a first position wherein it does not engage the slotted end of the arm 58 to a second position whereby the ramp engages the slotted end and concomitantly engages the pin 48 on the cable carrier with the slot 50 on the arm.

The forward surface of the front spacer 22 is a hemispherically-shaped surface adapted to mate with a spine segment 74. The spine segment 74 extends around the cable and protects the cable while permitting flexibility of the cable and positionability of the stapling head assembly remote from the handle actuator assembly. A plurality of spine segments extend around the cable between the handle actuator assembly and the stapling head assembly. Each of the spine segments 74 includes a cylindrical lumen 76 which at its forward end opens into a conical lumen. The forward facing surface of each spine segment is a hemispherically-shaped surface 78. The rearwardly facing surface of each spine segment is a hemispherically-shaped concave recess which is adapted to mate and coincide with the hemispherically-shaped forward surface of the adjacent spine segment. The spine segments abut one another and extend between the handle actuator assembly and stapling head assembly and translate a force which maintains that portion of the staple firing head assembly to which the fowardmost spine segment abuts in a fixed position relative to the cable. The operation will be hereinafter described with regard to the operation of the overall flexible stapling instrument assembly.

With regard to FIGURE 2, a preferred embodiment of a handle actuator assembly 80 is illustrated. Basically, the handle actuator assembly 80 shown in FIGURE 2 is similar to the handle actuator assembly 13 shown in FIGURE 1. The two handle actuator assemblies primarily differ in their gap adjustment assemblies.

The handle actuator assembly 80 shown in FIGURE 2 includes a housing 82. The housing includes a front spacer 84 which includes a hemispherically-shaped forward surface adapted to mate with a spine segment 85.

The housing defines a cavity 90 in which rides a cable carrier 88. The cable carrier 88 is freely slidable along a provided race between the forward end wall 92 and the rearward end wall 94 of the cavity in the housing. The cable carrier is attached to a cable 86 which extends through the forward end, front spacer, and spine segments.

The cable carrier includes an outwardly extending pin 96 which is designed to engage and cooperate with a slot 98 on an arm 100 which is pivotally connected through a pivot pin 102 to a lever 104 which in turn is pivotally linked through a pivot pin 106 to the housing. The arm 100 can be spring biased against the housing through a coil spring 105. Such a biasing coil spring 105 maintains a tension against the arm 100 such that the arm does not engage the pin 96 on the cable carrier until a force is exerted and maintained on the lever arm 104. The biasing spring 105 can be connected to the arm 100 and to a hole 107 provided on the housing.

Also provided in the cavity 90 is a ramp 108 which is freely slidable within the cavity. The ramp includes an extending pin 110 which extends outwardly of the housing through a slot 112. The extending pin 110 extends outwardly of the housing through the slot so as to be manually movable within the slot to correspondingly move the ramp. The ramp includes a sloped or inclined leading end which engages the slotted end of the arm 100 to move the slotted arm 100 to engage the slot 98 with the pin 96 on the cable carrier. The ramp serves as a safety means in that the staples cannot be fired until the ramp had been moved to engage the slot with the pin in the cable carrier.

The cable carrier 88 includes a recess 114 which is adapted to receive a connecting rod 116. The connecting rod is fastened in the cable carrier. The connecting rod is connected to or forms at its other end a threaded rod 118 which includes threads 124 on its outer surface. The threaded rod 118 and connecting rod 116 fit within the cable carrier and housing such that they do not rotate but move axially (or longitudinally) within the housing in the direction of the indicated arrows along the threaded rod.

A rotatable knob 120 is mated to the housing but freely rotatable with regard to the housing. The rotatable knob includes threads 122 on at least a portion of its inner surface which engage the threads 124 on the threaded rod. The rotatable knob 120 can be connected to the housing through pins 126 which mate with an annular channel on the rotatable knob to hold the rotatable knob on the housing but permit it to freely rotate. Rotation of the rotatable knob causes the threaded rod to move inwardly and outwardly of the handle housing, thereby concomitantly moving the cable carrier and cable. The function of the rotatable knob will be hereinafter described with regard to the overall operation of the flexible stapler instrument assembly.

With regard to FIGURE 3, there is shown a staple firing head assembly 14. As can be seen from the drawing, the staple firing head assembly 14 is connected to the handle actuator assembly through the cable 24 or 86, depending on whether the handle actuator assembly is that of FIGURE 1 or 2. The staple firing head assembly 14 is basically constructed of three components: a body 128; staple housing means constituted by a cartridge assembly 130; and an anvil assembly 132.

The body 128 includes a fixed pusher 166. The term fixed is used to mean that in a longitudinal reference frame relative to the handle actuator assembly and flexible spine assembly, the pusher 166 remains in a fixed position. The other elements of the body, as well as the cable, cartridge assembly, and anvil assembly do move relative to the pusher. The other elements of the body are an anvil shaft tube 140 slidably mounted within the pusher, and a bayonet member 150 slidably mounted on the anvil shaft tube 140.

The cable 24 extends through the staple firing head assembly and is attached to the anvil assembly by a cable retainer 136. The anvil assembly 132 includes an anvil shaft 134 which is generally cylindrical in shape and extends into the body and, more particularly, into the pusher and into a recess 138 on the anvil shaft tube 140 for the anvil shaft. The anvil is removably attached to the anvil shaft so that the staple cartridges can be inserted in the stapling instrument. The anvil shaft 134 is freely slidable within the recess 138 of the anvil shaft tube. That is, the anvil shaft 134 can freely slide within the recess and is biased within the anvil shaft tube by an anvil return spring 142 which is a coiled spring extending around the cable. The anvil return spring in a working embodiment was a helically wound spring having a preload of about 2.5 pounds (11.1 Newtons) and a final load of about 5 pounds (22.2 Newtons). The cable extends centrally through the anvil shaft and anvil shaft tube.

The body 128 is generally cylindrical in shape. However, the body can have other configurations such as a multi-sided tubular shape. The anvil shaft 134 is generally cylindrical in shape as is also the anvil shaft tube 140. Again, other tubal configurations can be used.

Extending outwardly from the anvil shaft tube 140 are two bayonet pins 144. The bayonet pins 144 are encircled by a collar 146. The collar 146 may be non-integral with the pins 144 as shown in Figure 3 or integral with the pins as shown in Figures 4 to 7. The bayonet pins extend through two provided slots 154 on the pusher 166 and through two slots 148 on the bayonet member 150. The slots 148 are preferably about 2 millimeters in length and provide for various thicknesses of tissue to be stapled. The function of the slots 148 and bayonet pins 144 will hereinafter be described with regard to the operation of the overall flexible stapling instrument assembly. The anvil shaft tube can slide within the slots 154 and 148 and thereby move relative to the pusher and bayonet.

The anvil shaft tube 140 is also slidable within the pusher 166. That is, the anvil shaft tube 140 rides within a recess 152 for such anvil shaft tube, which recess is within the pusher 166. The bayonet member 150 is also freely slidable concomitantly with the anvil shaft tube 140. The bayonet and anvil shaft tube move relative to the pusher 166. The bayonet member 150 is a generally cylindrical shape and includes a forward cylindrical extension designed to receive the cartridge assembly 130.

Extending around the pusher 166 is a tissue clamping compression spring 156. The tissue clamping spring 156 is fixed between a ledge 162 on the bayonet member 150 and the bayonet pins 144 on the anvil shaft tube (via the collar 146). The tissue clamping spring 156 biases the bayonet member 150 against the anvil shaft tube 140. In a working embodiment, the tissue clamping spring was a spring having a preload of about 5 pounds and a final load of about 9 pounds.

Also extending around the pusher 166 is a firing spring 158 which is a helically wound compression spring. In a working embodiment, the firing spring had a preload of about 16 pounds (71.2 Newtons) and a final load of about 23 pounds (102 Newtons). The firing spring is biased between the bayonet pins 144 of the anvil shaft tube 140 (via the collar 146) and an end cap 160 attached to the pusher 166. The end cap 160 includes a concave hemispherically-shaped recess 164 adapted to mate with the hemispherical forward surface of a spine segment.

The pusher 166 includes a forwardly extending cylindrical end which is designed to engage staple drivers within the cartridge assembly. The bayonet member 150 forms a cylindrical cavity or recess 168 for receiving the cartridge assembly 130. The flexible stapling instrument assembly herein has been designed for use with various commercially available staple carrying cartridge assemblies. The commercially available cartridge assemblies can be used in the instrument assembly herein. In particular, cartridge assemblies manufactured by U.S. Surgical Corporation, can be used in the instrument assembly herein. Suitable cartridge assemblies are described in U.S. Patent No. 4,304,236, the entire disclosure of which is incorporated herein by this reference. The cartridge assembly will be described herein in order to disclose the operation of the overall flexible stapling instrument assembly.

The typical cartridge assembly includes a cylindrical projection 170 which fits into the recess 168 on the bayonet. The cartridge assembly also includes a staple driver 172 which includes a plurality of integral individual drivers 174 which coincide and fit into staple receiving slots 178 wherein the staples 176 are located. There is one staple for each slot. Centrally located within the cartridge assembly is a cylindrical-shaped knife blade 180. The knife blade is movable in the cartridge and is moved by movement of the staple driver 172 as it also drives the staples. In the

cartridge assembly shown in FIGURE 3, the staples form two concentric circular patterns wherein the staples in one of the circular patterns overlap the gaps between staples in the other circular staple pattern. Coinciding with the staples in the cartridge assembly are a series of depressions 182 on the anvil surface of the anvil assembly 132.

The operation of the flexible stapler instrument assembly herein will be described with regard to the assembly shown in FIGURES 4-7. The flexible stapling instrument assembly shown in FIGURE 4 is an illustration of the assembly at rest and prior to use. The assembly shown in FIGURE 5 illustrates the approximation of tissue and the assembly illustrated in FIGURE 6 illustrates the approximation of a thicker tissue. The assembly illustrated in FIGURE 7 shows the assembly during the firing or immediately after the firing of the staples; i.e., the forming of the staples against the anvil surface. With regard to the following description of the assembly shown in FIGURES 4-7, the term "rearward" shall be used with reference to the handle actuator assembly end of the overall assembly while the term "forward" will be used with reference to the staple firing head assembly end of the overall assembly.

In FIGURE 4, the flexible stapling instrument assembly 10 is shown which includes a handle actuator assembly 12, a staple firing head assembly 14, and a flexible spine assembly 16 joining the handle actuator assembly and the staple firing head assembly. The flexible stapler instrument assembly 10 is shown in FIGURE 4 in its ready to use position. The anvil assembly 132 is usually drawn toward the cartridge assembly 130 before insertion into the tissue prior to clamping the tissue to be stapled. The gap in FIGURE 4 is shown somewhat exaggerated.

In the flexible stapler instrument assembly 10, and more particularly the stapling head assembly 14, the anvil assembly 132 is spaced from the staple cartridge 130 a distance sufficient to enable two tubular sections of an organ (which sections are to be stapled together) to be lapped over the opposing faces on the staple cartridge and the anvil assembly. The anvil return spring 142 is in its extended position holding the anvil assembly 132 spaced from the staple cartridge 130. The anvil shaft 134 is at the forward end of the anvil shaft tube 140, leaving the recess 138 for receiving the anvil shaft in the anvil shaft tube. The tissue clamping spring 156 is in its extended state holding the anvil shaft tube 140 in a position such that the bayonet pins 144 are positioned at the rearward end of the slot 148 in the body 128. The anvil shaft tube 140 is positioned within the pusher 166 such that a recess 152 remains between the end cap of the pusher and the rearward end of the anvil shaft tube.

With regard to the handle actuator assembly, the cable carrier 88 lies within the cavity of the handle actuator assembly 12 toward the forward end of such cavity; i.e., toward the front spacer 84. The threaded rod 118 which is connected to the cable carrier is positioned such that it extends into the cavity and only a relatively small portion extends toward the rotatable knob 120.

The lever assembly is positioned with the arm 100 disengaged from the extending pin 96 on the cable carrier and the spring tension on the lever 104 is such that the lever projects outwardly from the housing 82. The ramp 108 is positioned toward the forward end of the cavity such that the pin 110 is at the forward end of the slot 112. The ramp, thus, does not engage the arm 100.

FIGURE 5 illustrates a later position for the flexible stapler instrument assembly shown in FIGURE 4 at a stage wherein tissue is being approximated. That is, the tissue of the organs to be joined end to end would now be clamped between the anvil assembly 132 and the staple cartridge 130. In order to clamp the tissue, the rotatable knob 120 is rotated to engage the threaded rod 118 and to cause the threaded rod 118 to move rearwardly in the handle actuator assembly. The rotatable knob 120 rotates but does not move inward or outward with regard to the housing 82. The threaded shaft 118 does not rotate but moves rearwardly or forwardly, depending upon the rotation of the rotatable knob 120. As the rotatable knob is rotated, it draws the threaded rod 118 rearwardly and concomitantly pulls the cable carrier 88 rearwardly of the cavity 90 within the housing 82.

As the cable carrier 88 has been drawn rearward by the threaded rod 118, it also draws the cable 86 rearward through the housing 82, the flexible spine assembly 16 (through its individual spine segments 85), and through the pusher 166, and draws the anvil assembly 132 toward the staple cartridge 130. As can he seen in FIGURE 5, the anvil assembly 132 is spaced closely to the staple cartridge 130. In a normal stapling operation, the anvil would be spaced approximately 1 millimeter from the staple cartridge for normal thicknesses of tissue. The staple firing head assembly has also changed positions with regard to the individual element positions in FIGURE 4. As can be seen in FIGURE 5, the anvil shaft 134 has now compressed the anvil return spring and has filled the recess 138 within the anvil shaft tube 140. The tissue clamping spring 156 maintains the anvil shaft tube 140 positioned such that the bayonet pins 144 remain at the rearward end of the slot 148. In FIGURE 5, compression of the firing spring 158 has not yet begun.

It should also be noted that in FIGURE 5 the cable carrier 88 is properly positioned within the cavity 90 of the housing 82 such that the extending pin 96 can be engaged with the slot 98 on arm 100 of the trigger assembly. Ramp 108 remains in the position shown in FIGURE 4 at the forward end of the cavity 90 in the housing.

FIGURE 6 shows an alternative arrangement for the elements of the staple firing head assembly shown in FIGURE 5 when the handle actuator assembly is in the position shown in FIGURE 5. The orientation of the elements in FIGURE 6 provides a gap between the anvil assembly 132 and the staple cartridge which is relatively larger than the gap shown in FIGURE 5. For example, the configuration shown in FIGURE 6 can provide for the approximation of thicker tissues and the spacing can be about 3 millimeters for such thicker tissues.

The anvil shaft 134 has been drawn into the anvil shaft tube 140 filling the recess therein. As the anvil has been drawn rearward, it compresses the tissue and exerts a pressure through such tissue against the staple cartridge 130 which is connected to the bayonet 150. A compressive force is exerted against the tissue clamping spring 156 as the bayonet 150 is pulled rearwardly. The bayonet pins 144 thus engage the forward end of the slot 148 in the bayonet.

The two orientations of the elements of the staple firing head assembly shown in FIGURES 5 and 6 show the approximation of tissue between the anvil and staple cartridge and show the assembly in a condition for firing the staples into the tissue. The sequence of firing and the orientation of the various elements upon firing is shown in FIGURE 7. For the various configurations and arrangement of the elements shown in FIGURES 4-6, the anvil assembly, cartridge assembly, and bayonet of the staple firing head assembly have all been pulled rearward by the cable 86 which has been pulled rearward by the rotatable end cap 120 pulling the cable carrier. In order to fire the staples, the ramp 108 must be slid rearward by manually sliding the ramp by exerting a force on the pin 110 extending from the housing. The sloped or inclined rearward end of the ramp engages the arm 100 and slides such arm to engage the slot on the end of the arm with the extending pin 96 on the cable carrier as shown in FIGURE 7. The ramp 108 functions as a safety and prevents firing of the staples prior to the sliding of the ramp rearward to engage the slot on the arm with the pin.

With reference to FIGURE 7, the squeezing of the lever 104 toward the housing of the handle actuator assembly pivots the lever 104 and causes arm 100 to move rearwardly and drive the cable carrier rearwardly. The rearward movement of the cable carrier pulls the cable 86 through the housing, through the flexible spine assembly to fire the staples. The firing of the staples occurs with regard to the staple firing head assembly as the anvil assembly to which the cable is attached is drawn rearward and concomitantly pulls the staple housing rearward. The anvil shaft tube and bayonet also move rearward with respect to the staple pusher 166. The staple pusher 166 is maintained in a fixed position relative to the cable 86 by the exertion of a stationary retaining force through the spine segments which are connected to the pusher assembly at the rearward end cap 160. As the staple cartridge 130 moves rearward, it encounters the forward cylindrical projection on the pusher 166 which pushes against the staple drivers. The staple drivers and staples thus remain in a fixed position as the staple housing moves rearward away from the staples. The anvil surface, along with its depressions, moves toward the staples for forming the staples. The anvil shaft tube is pulled against the firing spring 158 which sits between the pusher and the anvil shaft tube.

In FIGURE 5, the anvil shaft 134 has bottomed out against the anvil shaft tube which correspondingly transmits the cable load to the bayonet pins 144 and the bayonet 150, causing the staple cartridge 130 to move together with the anvil assembly rearwards. In FIGURE 6, the anvil shaft has also bottomed out against the anvil shaft tube, but the staple cartridge 130 and bayonet 150 have been pushed by the thicker tissue rearwards relative to the anvil shaft tube 140 and bayonet pins 144, causing the tissue compression spring 156 to deflect and the bayonet pins 144 to be at the forward end of slots 148.

To fire the staples in a working embodiment, the cable carrier is moved rearwardly about one-quarter to about three-eighths of an inch by actuation of the lever 104 and arm 100. Before clamping tissue, the initial gap between the anvil surface and the staple cartridge in a working embodiment is approximately one and three-quarter inches as shown in FIGURE 4.

In regard to FIGURE 8, another type of staple firing head assembly is illustrated. The staple firing head assembly 15 shown in FIGURE 8 provides a linear staple pattern and generally such an instrument does not include a knife blade. The staple firing head assembly 15 in FIGURE 8 includes a body 184 which is generally cylindrical in shape and hollow defining a cavity 194. The cable 24 or 86 (depending on the choice of handle actuator assembly) extends through the body. The body includes an end cap 29 having a hemispherical recess for receiving the hemispherically-shaped spine segment 78.

The staple firing head assembly 15 includes on anvil carrier 188 which includes an anvil 186. The

anvil 186 provides an anvil surface consisting of a plurality of staple forming depressions or grooves. The anvil carrier is somewhat C-shaped and includes an anvil carrier shaft 192 which is generally cylindrical tubular shaped and which fits into and is received in the cavity 194 of the body of the staple firing head assembly. The anvil carrier shaft and thereby the anvil carrier are slidingly engaged with the cavity 194 of the body and is free to slide within such cavity.

The anvil carrier includes an anvil carrier end cap 190 on the rearward end of the anvil carrier shaft. The anvil carrier end cap is adapted to receive and connect with a fitting on the end of the cable 24. The anvil carrier shaft 192 is hollow and defines a cavity 204 which slidingly receives a cartridge holder shaft 202.

The staple firing head assembly includes a cartridge holder 198 which provides an opposing surface on which a staple cartridge can be inserted opposite the anvil surface. The cartridge holder 198 is adapted to receive a cartridge 196 which contains the staples to be fired. The cartridge holder 198 includes the cartridge holder shaft 202 which extends into the cavity 204 of the anvil carrier shaft. The cartridge holder shaft 202 is spring biased against the anvil carrier 188 by an anvil return spring 208. The anvil return spring can be a helically wound compression spring which extends around the cartridge holder shaft and engages a ledge 212 at the rearward end thereof. The forward end of the anvil return spring engages the anvil carrier. The anvil return spring can have a preload of about 2 pounds (8.9 Newtons) and a final load of about 5 pounds (22.2 Newtons) and a spring force of about 5 pounds (22.2 Newtons) per inch (2.54 cm).

A pusher head 206 is disposed within the cartridge holder 198. The pusher head is designed to apply a force against the staple drivers, forcing the staple drivers against the staples and the staples from the staple recesses and against the staple forming grooves on the anvil surface.

A pusher assembly 200 includes a shaft that is attached to the body 184. Thus, the pusher assembly 200 does not move relative to the body 184 which is abutted against the spine segments so that the body 184 does not move relative to the handle actuator assembly. That is, the cable moves relative to the body 184 and pusher assembly.

Extending around the pusher shaft is a staple firing spring 210. The staple firing spring provides a spring bias between the cartridge holder/anvil carrier and the housing. The staple firing spring can have a preload of about 7.5 pounds (60.0 Newtons) and a final load of about 11.5 pounds (51.1 Newtons) and a spring force of about 13.5 pounds (60.0 Newtons) per inch (2.54 cm).

The staple firing head assembly 15 shown in FIGURE 8 represents the staple firing head assembly at its rest or normal position prior to use. In such a position, it would be connected to a handle actuator assembly which would be in the configuration of the handle actuator assembly shown in FIGURE 4.

FIGURE 9 represents the staple firing head assembly 15 shown in FIGURE 8 while in use and showing the approximation of tissue between the anvil surface and staple cartridge. In such a state shown in FIGURE 9, the handle actuator assembly would be in the position as the handle actuator assembly shown in FIGURE 5. That is, the rotatable knob would be turned to draw the cable carrier and cable through the housing of the handle actuator assembly. As the cable is drawn through the handle actuator assembly, it is also drawn through the flexible spine 16 and through the housing body 184 of the staple firing head assembly. The cable is attached to the anvil carrier and draws the anvil carrier and anvil surface toward the staple cartridge. As the anvil carrier is drawn rearwardly by the cable, it compresses the anvil return spring 208. The anvil carrier shaft 192 is drawn into the cavity 194 on the body 184.

The staple firing head assembly 15 shown in FIGURE 10 represents the assembly upon firing or forming of the staples. In the configuration shown in FIGURE 10, the handle actuator assembly would be positioned the same as the handle actuator assembly shown in FIGURE 7. That is, in the handle actuator assembly the slotted arm 100 would be engaged with the pin on the cable carrier and, upon actuation of the lever 104, the arm 100 would force the cable carrier rearward, thereby pulling the cable rearward. With the pulling of the cable rearward, there would be a corresponding pulling of the cable through the staple firing head assembly 15 which would pull the anvil carrier shaft 192 toward the rearward end of the cavity 194 and the body 184. The anvil carrier shaft would be pulled against the firing spring 210. As the anvil carrier is pulled against the firing spring 210, the spring would exert a force against the pusher shaft 202 to resist movement of such pusher shaft by the spring force. The firing spring 210 is also biased against the body 184 which does not move relative to the moving cable. As the cable is pulled rearward, the cartridge holder shaft 202 pulls the cartridge holder 198 rearwardly. As the cartridge holder and cartridge continue to move rearward, the staples are forced outwardly of the cartridge by the pusher head and against the grooves in the anvil surface whereby they are formed.

Claims

1. A flexible surgical stapler (10) for applying an array of staples (176) to tissue, the stapler comprising:
a staple firing head assembly (14,15) comprising:
an anvil assembly means (132,186) having an anvil surface with an array of staple forming depressions (182) therein;
a staple housing means (130,196) for carrying the array of staples; and
a staple pusher means (166,206) for exerting a force on the staples in the staple housing means to eject the staples from the staple housing means and form the staples against the anvil surface;
a handle actuator assembly (12,80) comprising:
a housing (18,82) defining an inner cavity (30,90) therein;
a cable carrier (24,88) slidable within the cavity;
a length of flexible cable (24,86) connected at one of its ends to the cable carrier and at its other end to the anvil assembly means of the staple firing head assembly; and
a handle means (54,58,104,100) on the housing selectively operatively connected to the cable carrier for moving the cable carrier and concomitantly forcing the staples out of the staple housing means and forming the staples against the anvil surface; and
static means (74,85) extending between the handle actuator assembly and staple firing head assembly for maintaining the staple pusher means in a fixed position with regard to movement toward the handle actuator assembly along the length of flexible cable;
the anvil assembly means being movable by the cable from an open position, wherein the anvil surface is substantially spaced from the staple housing means, to a tissue approximation position, wherein the anvil surface is closely spaced from the staple housing means for approximating tissue, the anvil assembly means and staple housing means being cooperatively movable by the cable with respect to the staple pusher means toward the handle actuator assembly from the tissue approximation position to a firing position, wherein the staples are forced from the staple housing means against the anvil surface by the staple pusher means.

2. A stapler (10) as recited in claim 1 wherein the cable carrier further comprises connecting means for selectively connecting the handle means (54,104) to the cable (24,86), the connecting means on the cable carrier (28,88) comprising an extending pin (48,96) for engaging the handle means.

3. A stapler (10) as recited in claim 2 wherein the handle means comprises a first lever arm (54,104) pivotally attached to the housing (18,82) and a second lever arm (58,100) pivotally attached to the first lever arm and selectively attachable to the cable carrier (28,88), the second lever arm having a slot (50,98) which can be engaged with the extending pin (48,96) on the cable carrier.

4. A stapler (10) as recited in claim 3 further comprising slidable ramp means (64,108) in the housing (18,82) cooperatively engageable with the second lever arm (58,100) to engage the slot (50,98) on the second lever arm of the handle means (54,58,100,104)with the extending pin (48,96) on the cable carrier (28,88).

5. A stapler (10) as recited in any preceding claim wherein the static means comprises a plurality of individual interconnecting cylindrical spine segments (74,85) each having hemisperically-shaped concave and convex ends (78) and a centrally extending lumen (76) through which the cable extends.

6. A stapler (10) as recited in any preceding claim further comprising tissue gap adjustment means on the handle actuator assembly (12,80) and operatively connected to the cable carrier (28,88) for selectively adjusting the distance between the anvil surface and the staple housing means (130,196).

7. A stapler (10) as recited in claim 6 wherein the tissue gap adjustment means comprises a rotatable knob (42) rotatingly connected to the housing (18) of the handle actuator assembly (12) and operatively connected to the cable carrier (28) such that rotation of the rotatable knob moves the cable carrier and the cable (24) and concomitantly moves the anvil assembly means (132) toward the staple housing means (130).

8. A stapler (10) as recited in claim 6 wherein the tissue gap adjustment means comprises a rotatable knob (120) keyed to the housing (82) of the handle actuator assembly (80) and including a centrally, axially extending threaded lumen and a threaded rod (118) in the threaded lumen, which threaded rod is connected to the cable carrier (88), whereby the threaded

rod does not rotate but moves axially of the threaded lumen, such that rotation of the rotatable knob moves the threaded rod, the cable carrier and the cable (86) and concomitantly moves the anvil assembly means (186) toward the staple housing means (196).

9. A stapler (10) as recited in any preceding claim wherein the staple firing head assembly (14,15) further comprises an anvil shaft (134,192) on the anvil assembly means, which anvil shaft is slidingly connected to the staple pusher means (166,206) the staple housing means (130,196) being slidingly connected to the staple pusher means such that the staple housing means moves relative to the staple pusher means a distance sufficient to eject staples from the staple housing means and form the staples against the anvil surface.

10. A stapler (10) as recited in claim 9 further comprising a first spring biasing means (142,208) for biasing the anvil assembly means (132,188) against the staple housing means (130,196) and second spring biasing means (158,210) for biasing the staple housing means and anvil assembly means against the staple pusher means (166,200).

11. A stapler (10) as recited in claim 10 wherein the first spring biasing means (142,208) comprises a lesser spring force than the spring force for the second spring biasing means (158,210).

12. A stapler (10) as recited in claim 11 wherein the spring force of the first spring biasing means (142,208) comprises a spring force relative to the spring force of the second spring biasing means (158,210) such that the anvil assembly means (132,188) moves relative to the staple housing means (130,196) then upon overcoming the first spring biasing means, the anvil assembly means and staple housing means move relative to the staple pusher means (166,200) against such second spring biasing means.

13. A stapler (10) as recited in any of claims 10 to 12 further comprising an anvil shaft receiver means (140) for selectively adjusting the spacing between the anvil surface and the staple housing means (130), which anvil shaft receiver means is slidingly connected to the staple pusher means (166) and adapted to slidingly receive the anvil shaft (134).

14. A stapler (10) as recited in claim 13 further comprising a third spring biasing means (156) for biasing the anvil shaft receiver means (140) against the staple housing means (130) and wherein the first spring biasing means (142) biases the anvil assembly means (132) against the anvil shaft receiver means (140) and wherein the second spring biasing means (158) biases the anvil assembly means, anvil shaft receiver means, and staple housing means (130) against the staple pusher means (166).

15. A stapler (10) as recited in claim 14 wherein the first spring biasing means (142) comprises a spring force less than the spring force of the third biasing means (156), which third biasing means comprises a spring force less than the spring force of the second spring biasing means (158).

16. A stapler (10) as recited in claim 15 wherein the relative spring forces of the first, second, and third spring biasing means (142,158,156) are such that the anvil assembly means (132) moves relative to the anvil shaft receiver means (140) until the first spring biasing means is overcome, then the anvil assembly means and staple housing means (130) move relative to the staple pusher means until the third spring biasing means is overcome, .and then the anvil assembly means, staple housing means, and anvil shaft receiver means move relative to the staple pusher means against the second spring biasing means.

17. A stapler (10) as recited in claim 1 wherein the staple firing head assembly (14,15) further comprises:
an anvil shaft (134) on the anvil assembly means (132) slidingly engaged with the staple pusher means (166);
a first spring biasing means (142,156) for biasing the anvil assembly means against the staple housing means (130); and
a second spring biasing means (158) for biasing the staple housing means against the staple pusher means.

18. A stapler (10) as recited in claim 17 further comprising an anvil shaft receiver means (140) slidingly mounted with respect to the staple pusher means (166) and which is adapted to slidingly receive the anvil shaft; the first spring biasing means comprising a first spring (142) biasing the anvil assembly means (132) against the anvil shaft receiver means (140) and a second spring (156) biasing the anvil shaft receiver means against the staple hous-

ing means; and the second spring biasing means (158) biasing the anvil shaft receiver means and staple housing means (130) against the staple pusher means (166).

19. A handle actuator assembly (12,80) for use with a flexible surgical stapling instrument, the handle actuator assembly comprising:
a housing (18,82) defining an inner cavity (30,90) therein;
a cable carrier (28,88) movable within the cavity including cable connection means for connecting the cable carrier means to a length of flexible cable (24,86);
a pin (48,96) extending from the cable carrier;
a first lever arm (54,104) pivotally attached to the housing;
a second lever arm (58,100) pivotally attached to the first lever arm and a slot (50,98) on the second lever arm whereby the second lever arm is cooperatively attachable through the slot to the extending pin of the cable carrier; and
tissue approximation means (42,120) on the housing operatively connected to the cable carrier for selectively adjusting the position of the cable carrier within the cavity; and
slidable ramp means (64,108) in the housing cooperatively engageable with the second lever arm to engage the slot on the second lever arm with the extending pin on the cable carrier.

20. A staple firing head assembly adapted for use with a flexible surgical stapling instrument, the staple firing head assembly comprising:
a staple cartridge receiving means (150,198) for receiving a cartridge (130,196) carrying an array of staples and staple drivers (172) for such staples;
an anvil assembly means (132,186,188) including an anvil surface having an array of staple forming depressions (182) thereon;
an anvil shaft (134,192) on the anvil assembly means; and
staple pusher means (186,200) comprising a forwardly extending head or end for contacting the staple drivers to force the staple drivers against the staples in the cartridge thereby forcing the staples against the staple forming depressions on the anvil surface as the staple cartridge receiving means, the anvil assembly means, and the anvil shaft move rearwardly toward the staple pusher means.

21. An assembly as recited in claim 20 further comprising a first spring biasing means (142,156,208) for biasing the anvil assembly means (132,186,188) against the staple cartridge receiving means (150,198) and second spring biasing means (156,210) for biasing the staple cartridge receiving means (150,198) and the anvil assembly means against the staple pusher means (166,200).

22. An assembly as recited in claim 21 further comprising an anvil shaft receiver means (140) for selectively adjusting the spacing between the anvil surface and a staple cartridge (130) in the staple cartridge receiving means (150), which anvil shaft receiver means is slidingly connected to the staple pusher means (166) and adapted to slidingly receive the anvil shaft (134).

23. An assembly as recited in claim 22 wherein the first spring biasing means comprises a first spring (142) for biasing the anvil shaft receiver means (140) against the staple cartridge receiving means (150) and a second spring (156) for biasing the anvil assembly means (132) against the anvil shaft receiver means, and the second spring biasing means (156) biases the anvil assembly means (132), anvil shaft receiver means, and the staple cartridge receiving means against the staple pusher means (166).

24. An assembly as recited in any of claims 20 to 23 further comprising a length of flexible cable (24,86) connected at one of its ends to the anvil assembly (132,186,188).

25. An assembly as recited in claim 24 wherein the length of flexible cable (24) extends through the staple cartridge receiving means (150) and through the staple pusher means (166) of the staple firing head assembly.

Revendications

1. Agrafeuse chirurgicale flexible (10), destinée à appliquer une rangée d'agrafes (176) à un tissu, l'agrafeuse comprenant :
un assemblage (14, 15) de tête de lancement d'agrafes, comprenant :
un moyen d'assemblage d'enclume (132, 186) muni d'une surface d'enclume dans laquelle est pratiquée une rangée de dépressions (182) destinées à façonner les agrafes ;
un moyen de logement d'agrafes (130, 196) destiné à supporter la rangée d'agrafes ; et
un moyen pousseur d'agrafes (166, 206) destiné à exercer une force sur les agrafes dans le moyen de logement destiné aux agrafes, dans le but d'éjecter ces dernières hors du moyen

de logement d'agrafes et de façonner les agrafes contre la surface d'enclume ;
un assemblage de dispositif d'entraînement à poignée (12, 80) comprenant :
un logement (18, 82) définissant une cavité interne (30, 90) pratiquée dans le logement ;
un support de câble (28, 88) apte à coulisser au sein de la cavité ;
une longueur de câble flexible (24, 86) reliée à une de ses extrémités au support de câble et à son autre extrémité, au moyen d'un assemblage d'enclume de l'assemblage de tête de lancement d'agrafes ; et
un moyen de poignée (54, 58, 104, 100) disposé sur le logement et relié sélectivement en entraînement au support de câble, afin de déplacer le support de câble et simultanément, de pousser les agrafes hors du moyen de logement d'agrafes et de façonner les agrafes contre la surface d'enclume ; et
un moyen statique (74, 85) s'étendant entre l'assemblage de dispositif d'entraînement à poignée et l'assemblage de tête de lancement d'agrafes, destiné à maintenir le moyen pousseur d'agrafes dans une position fixe, par rapport au mouvement s'exerçant en direction de l'assemblage de dispositif d'entraînement à poignée sur la longueur du câble flexible ;
le moyen d'assemblage d'enclume peut se déplacer par l'intermédiaire du câble, depuis une position ouverte dans laquelle la surface d'enclume est essentiellement écartée du moyen de logement d'agrafes, jusqu'à une position d'approche de tissu, dans laquelle la surface d'enclume se trouve à proximité du moyen de logement d'agrafe, dans le but de s'approcher du tissu, le moyen d'assemblage d'enclume et le moyen de logement d'agrafes pouvant se déplacer en entraînement conjoint par l'intermédiaire du câble, par rapport au moyen pousseur d'agrafes, en direction de l'assemblage du dispositif d'entraînement à poignée, depuis la position d'approche du tissu jusqu'à une position de lancement, dans laquelle les agrafes sont poussées depuis le moyen de logement d'agrafes contre la surface d'enclume, par l'intermédiaire du moyen pousseur d'agrafes.

2. Agrafeuse (10) selon la revendication 1, dans laquelle le support de câble comprend, en outre, un moyen de raccordement destiné à relier sélectivement le moyen de poignée (54, 104) au câble (24, 86), le moyen de raccordement disposé sur le support de câble (28, 88) comprenant une broche (48, 98) faisant saillie et destinée à venir s'engrener avec le moyen de poignée.

3. Agrafeuse (10) selon la revendication 2, dans laquelle le moyen de poignée comprend un premier bras de levier (54, 104) fixé en pivotement au logement (18, 82), ainsi qu'un second bras de levier (58, 100) fixé en pivotement au premier bras de levier et pouvant se fixer sélectivement au support de câble (28, 88), une fente (54, 98) étant pratiquée dans le second bras de levier, qui peut s'engrener avec la broche (48, 96) faisant saillie par rapport au support de câble.

4. Agrafeuse (10) selon la revendication 3, comprenant, en outre, un moyen de rampe (64, 108) apte à coulisser au sein du logement (18, 82) et qui peut venir se mettre en contact, en entraînement conjoint, avec le second bras de levier (58, 100) pour que la fente (50, 98) disposée sur le second bras de levier du moyen de poignée (54, 58, 100, 104) vienne s'engrener avec la broche (48, 96) faisant saillie par rapport au support de câble (28, 88).

5. Agrafeuse (10) selon l'une quelconque des revendications précédentes, dans laquelle le moyen statique comprend plusieurs segments individuels d'interconnexion (74, 85) à pointes cylindriques, chaque segment comprenant des extrémités concaves et convexes (78) en forme de demi-sphères, ainsi qu'une lumière (76) s'étendant en position centrale et à travers laquelle s'étend le câble.

6. Agrafeuse (10) selon l'une quelconque des revendications précédentes, comprenant, en outre, un moyen destiné à s'ajuster à l'écartement du tissu, disposé sur l'assemblage de dispositif d'entraînement à poignée (12, 80) et relié en entraînement au support de câble (28, 88) afin de régler sélectivement la distance entre la surface d'enclume et le moyen de logement d'agrafes (130, 196).

7. Agrafeuse (10) selon la revendication 6, dans laquelle le moyen destiné à s'ajuster à l'écartement du tissu comprend un bouton rotatif (42) relié en rotation au logement (18) de l'assemblage de dispositif d'entraînement à poignée (12) et relié en entraînement au support de câble (28), de telle sorte que la rotation du bouton rotatif déplace le support de câble et le câble (24), et déplace simultanément le moyen d'assemblage d'enclume (132) en direction du moyen de logement d'agrafes (130).

8. Agrafeuse (10) selon la revendication 6, dans laquelle le moyen destiné à s'adapter à l'écartement du tissu comprend un bouton rotatif

(120) claveté au logement (82) de l'assemblage de dispositif d'entraînement à poignée (80) et englobant une lumière centrale filetée s'étendant axialement, ainsi qu'une tige filetée (118) disposée dans la lumière filetée, la tige filetée étant reliée au support de câble (88), faisant ainsi en sorte que la tige filetée n'effectue pas des rotations mais se déplace axialement par rapport à la lumière filetée, de telle sorte que la rotation du bouton rotatif déplace la tige filetée, le support de câble et le câble (86) et déplace simultanément le moyen d'assemblage d'enclume (186) en direction du moyen de logement d'agrafes (196).

9. Agrafeuse (10) selon l'une quelconque des revendications précédentes, dans laquelle l'assemblage de tête de lancement d'agrafes (14, 15) comprend, en outre, un arbre d'enclume (134, 192) disposé sur le moyen d'assemblage d'enclume, cet arbre d'enclume étant relié en coulissement au moyen pousseur d'agrafes (166, 206), le moyen de logement d'agrafes (130, 196) étant relié en coulissement au moyen pousseur d'agrafes, de telle sorte que le moyen de logement d'agrafes se déplace par rapport au moyen pousseur d'agrafes, sur une distance suffisante pour éjecter les agrafes hors du moyen de logement d'agrafes et pour façonner les agrafes contre la surface d'enclume.

10. Agrafeuse (10) selon la revendication 9, comprenant, en outre, un premier moyen de sollicitation préliminaire à ressort (142, 208), destiné à exercer une sollicitation préliminaire sur le moyen d'assemblage d'enclume (130, 288) à l'encontre du moyen de logement d'agrafes (130, 196), ainsi qu'un deuxième moyen de sollicitation préliminaire à ressort (158, 210), destiné à exercer une sollicitation préliminaire sur le moyen de logement d'agrafes et le moyen d'assemblage d'enclume, à l'encontre du moyen pousseur d'agrafes (166, 200).

11. Agrafeuse (10) selon la revendication 10, dans laquelle le premier moyen de sollicitation préliminaire à ressort (142, 208) est animé d'une force de ressort inférieure à la force de ressort s'exerçant par l'intermédiaire du deuxième moyen de sollicitation préliminaire à ressort (158, 210).

12. Agrafeuse (10) selon la revendication 11, dans laquelle la force de ressort s'exerçant par l'intermédiaire du premier moyen de sollicitation préliminaire à ressort (142, 208) représente, par rapport à la force de ressort du deuxième moyen de sollicitation préliminaire à ressort (158, 210), une force de ressort telle que le moyen d'assemblage d'enclume (132, 188) se déplace par rapport au moyen de logement d'agrafes (130, 196) ; ensuite, après avoir vaincu le premier moyen de sollicitation préliminaire à ressort, le moyen d'assemblage d'enclume et le moyen de logement d'agrafes se déplacent par rapport au moyen pousseur d'agrafes (166, 206) à l'encontre du deuxième moyen de sollicitation préliminaire à ressort.

13. Agrafeuse (10) selon l'une quelconque des revendications 10 à 12, comprenant, en outre, un moyen (140) dans lequel vient se loger l'arbre d'enclume, destiné à régler sélectivement l'écartement ménagé entre la surface d'enclume et le moyen de logement d'agrafes (130), ce moyen dans lequel vient se loger l'arbre d'enclume étant relié en coulissement au moyen pousseur d'agrafes (166) et conçu pour que vienne s'y loger, en coulissement, l'arbre d'enclume (134).

14. Agrafeuse (10) selon la revendication 13, comprenant, en outre, un troisième moyen de sollicitation à ressort (156), destiné à exercer une sollicitation préliminaire sur le moyen (140) dans lequel vient se loger l'arbre d'enclume, à l'encontre du moyen de logement d'agrafes (130) et dans laquelle le premier moyen de sollicitation préliminaire à ressort (142) exerce une sollicitation préliminaire sur le moyen d'assemblage d'enclume (132), à l'encontre du moyen (140) dans lequel vient se loger l'arbre d'enclume et dans laquelle le deuxième moyen de sollicitation préliminaire à ressort (148) exerce une sollicitation préliminaire sur le moyen d'assemblage d'enclume, sur le moyen dans lequel vient se loger l'arbre d'enclume et sur le moyen de logement d'agrafes (130), à l'encontre du moyen pousseur d'agrafes (166).

15. Agrafeuse (10) selon la revendication 14, dans laquelle le premier moyen de sollicitation préliminaire à ressort (142) est animé d'une force de ressort inférieure à la force de ressort du troisième moyen de sollicitation préliminaire (156), le troisième moyen de sollicitation préliminaire étant animé d'une force de ressort inférieure à la force de ressort du deuxième moyen de sollicitation préliminaire à ressort (158).

16. Agrafeuse (10) selon la revendication 15, dans laquelle les forces relatives de ressort des premier, deuxième et troisième moyens de sollicitation préliminaire à ressort (142, 158,

156) sont telles que le moyen d'assemblage d'enclume (132) se déplace par rapport au moyen (140) dans lequel vient se loger l'arbre d'enclume, jusqu'à ce que le premier moyen de sollicitation préliminaire à ressort soit vaincu ; ensuite, le moyen d'assemblage d'enclume et le moyen de logement d'agrafes (130) se déplacent par rapport au moyen pousseur d'agrafes, jusqu'à ce que le troisième moyen de sollicitation préliminaire à ressort soit vaincu ; et, ensuite, le moyen d'assemblage d'enclume, le moyen de logement d'agrafes et le moyen dans lequel vient se loger l'arbre d'enclume se déplacent par rapport au moyen pousseur d'agrafes, à l'encontre du second moyen de sollicitation préliminaire à ressort.

17. Agrafeuse (10) selon la revendication 1, dans laquelle l'assemblage de tête de lancement d'agrafes (14, 15) comprend, en outre :
un arbre d'enclume (134) disposé sur le moyen d'assemblage d'enclume (132), qui vient s'engrener en coulissement avec le moyen pousseur d'agrafes (166) ;
un premier moyen de sollicitation préliminaire à ressort (142, 156), destiné à exercer une sollicitation préliminaire sur le moyen d'assemblage d'enclume à l'encontre du moyen de logement d'agrafes (130) ; et
un deuxième moyen de sollicitation préliminaire à ressort (158), destiné à exercer une sollicitation préliminaire sur le moyen de logement d'agrafes à l'encontre du moyen pousseur d'agrafes.

18. Agrafeuse (10) selon la revendication 17, comprenant, en outre, un moyen (140) dans lequel vient se loger un arbre d'enclume, monté en coulissement par rapport au moyen pousseur d'agrafes (166) et qui est conçu pour que vienne s'y loger, en coulissement, l'arbre d'enclume ; le premier moyen de sollicitation préliminaire à ressort comprend un premier ressort (142) exerçant une sollicitation préliminaire sur le moyen d'assemblage d'enclume (132) à l'encontre du moyen (140) dans lequel vient se loger l'arbre d'enclume, ainsi qu'un deuxième ressort (156) exerçant une sollicitation préliminaire sur le moyen dans lequel vient se loger l'arbre d'enclume, à l'encontre du moyen de logement d'agrafes ; et le deuxième moyen de sollicitation préliminaire à ressort (158) exerce une sollicitation préliminaire sur le moyen dans lequel vient se loger l'arbre d'enclume et sur le moyen de logement d'agrafes (130), à l'encontre du moyen pousseur d'agrafes (166).

19. Assemblage de dispositif d'entraînement à poignée (12, 80), destiné à être utilisé avec un instrument flexible chirurgical d'agrafage, l'assemblage de dispositif d'entraînement à poignée comprenant :
un logement (18, 82) définissant une cavité interne (30, 90) pratiquée dans le logement ;
un support de câble (28, 88) apte à se déplacer au sein de la cavité, comprenant un moyen de raccordement de câble destiné à relier le moyen de support de câble à une longueur de câble flexible (24, 86) ;
une broche (48, 96) faisant saillie par rapport au support de câble ;
un premier bras de levier (54, 104) fixé en pivotement au logement ;
un second bras de levier (58, 100) fixé en pivotement au premier bras de levier, ainsi qu'une fente (50, 98) pratiquée dans le second bras de levier, le second bras de levier pouvant ainsi se fixer en entraînement conjoint, par l'intermédiaire de la fente, à la broche faisant saillie par rapport au support de câble ; et
un moyen d'approche de tissu (42, 120) disposé sur le logement est relié en entraînement au support de câble, afin de régler sélectivement la position du support de câble au sein de la cavité ; et
un moyen de rampe apte à coulisser (64, 108), disposé au sein du logement et pouvant venir s'engrener en entraînement conjoint avec le second bras de levier, pour que la fente pratiquée dans le second bras de levier vienne s'engrener avec la broche faisant saillie par rapport au support de câble.

20. Assemblage de tête de lancement d'agrafes, conçu pour être utilisé avec un instrument flexible chirurgical d'agrafage, l'assemblage de tête de lancement d'agrafes comprenant :
un moyen (150, 193) dans lequel vient se loger une cartouche d'agrafes, destiné à recevoir une cartouche (130, 196) supportant une rangée d'agrafes et des entraîneurs d'agrafes (172) destinés à ces dernières ;
un moyen d'assemblage d'enclume (132, 186, 188) comprenant une surface d'enclume dans laquelle est pratiquée une rangée de dépressions (182) destinées à façonner les agrafes ;
un arbre d'enclume (134, 192) disposé sur le moyen d'assemblage d'enclume ; et
un moyen pousseur d'agrafes (186, 200) comprenant une extrémité ou une tête faisant saillie vers l'avant, destinée à venir se mettre en contact avec les entraîneurs d'agrafes afin de pousser les entraîneurs d'agrafes contre les agrafes dans la cartouche, poussant ainsi les agrafes contre les dépressions destinées à fa-

çonner les agrafes et pratiquées sur la surface d'enclume, à mesure que le moyen dans lequel vient se loger la cartouche d'agrafes, le moyen d'assemblage d'enclume et l'arbre d'enclume se déplacent vers l'arrière en direction du moyen pousseur d'agrafes.

21. Assemblage selon la revendication 20, comprenant, en outre, un premier moyen (142, 156, 208) de sollicitation préliminaire à ressort, destiné à exercer une sollicitation préliminaire sur le moyen d'assemblage d'enclume (132, 186, 188) à l'encontre du moyen (150, 198) dans lequel vient se loger la cartouche d'agrafes, ainsi qu'un deuxième moyen (156, 210) de sollicitation préliminaire à ressort, destiné à exercer une sollicitation préliminaire sur le moyen (150, 198) dans lequel vient se loger la cartouche d'agrafes et sur le moyen d'assemblage d'enclume, à l'encontre du moyen pousseur d'agrafes (166, 200).

22. Assemblage selon la revendication 21, comprenant, en outre, un moyen (140) dans lequel vient se loger l'arbre d'enclume, destiné à régler sélectivement l'écartement ménagé entre la surface d'enclume et une cartouche d'agrafes (130) au sein du moyen (150) dans lequel vient se loger la cartouche d'agrafes, le moyen dans lequel vient se loger l'arbre d'enclume étant relié en coulissement au moyen pousseur d'agrafes (166) et conçu pour que vienne s'y loger, en coulissement, l'arbre d'enclume (134).

23. Assemblage selon la revendication 22, dans lequel le premier moyen de sollicitation préliminaire à ressort comprend un premier ressort (142) destiné à exercer une sollicitation préliminaire sur le moyen (140) dans lequel vient se loger l'arbre d'enclume, à l'encontre du moyen (150) dans lequel vient se loger la cartouche d'agrafes, ainsi qu'un deuxième ressort (156) destiné à exercer une sollicitation préliminaire sur le moyen d'assemblage d'enclume (132), à l'encontre du moyen dans lequel vient se loger l'arbre d'enclume, le deuxième moyen (156) de sollicitation préliminaire à ressort exerçant une sollicitation préliminaire sur le moyen d'assemblage d'enclume (132), sur le moyen dans lequel vient se loger l'arbre d'enclume et sur le moyen dans lequel vient se loger la cartouche d'agrafes, à l'encontre du moyen pousseur d'agrafes (166).

24. Assemblage selon l'une quelconque des revendications 20 à 23, comprenant, en outre, une longueur de câble flexible (24, 86) reliée, à une de ses extrémités, à l'assemblage d'enclume (132, 186, 188).

25. Assemblage selon la revendication 24, dans lequel la longueur du câble flexible (24) s'étend à travers le moyen (150) dans lequel vient se loger la cartouche d'agrafes et à travers le moyen pousseur d'agrafes (166) de l'assemblage de tête de lancement d'agrafes.

Ansprüche

1. Flexibles chirurgisches Klammergerät (10) zum Anbringen einer Reihe von Klammern (176) an Gewebe, bestehend aus:
einer Klammerschließvorrichtung (14, 15) mit:
einem Amboßelement (132, 188), welches eine Amboßfläche mit einer Reihe von Klammerformvertiefungen (182) aufweist;
einem Klammergehäuse (130, 196) zum Aufnehmen der Reihe von Klammern; und
einer Klammerstoßeinrichtung (166, 206) zum Aufbringen einer Kraft auf die Klammern in dem Klammergehäuse, um die Klammern aus dem Klammergehäuse auszustoßen und die Klammern an der Amboßfläche zu formen;
einer Handgriffbetätigungsvorrichtung (12, 80) mit:
einem einen inneren Hohlraum (30, 90) umschließenden Gehäuse (18, 82);
einem innerhalb des Hohlraums verschiebbaren Drahtseil-Mitnehmer (28, 88);
einer Länge eines flexiblen Drahtseils (24, 86), welches mit einem seiner Enden mit dem Drahtseil-Mitnehmer und mit seinem anderen Ende mit dem Amboßelement der Klammerschließvorrichtung verbunden ist; und
einer an dem Gehäuse angeordneten Griffeinrichtung (54, 58, 104, 100),die selektiv mit dem Drahtseil-Mitnehmer wirkverbunden ist, um den Drahtseil-Mitnehmer zu bewegen und gleichzeitig die Klammern aus dem Klammergehäuse zu drängen und an der Amboßfläche zu formen; sowie
einem sich zwischen der Handgriffbetätigungsvorrichtung und der Klammerschließvorrichtung erstreckenden Statikelement (74, 85) zum Halten der Klammerstoßeinrichtung in einer bestimmten Position bezüglich der Bewegung auf die Handgriffbetätigungsvorrichtung zu längs der Länge des flexiblen Drahtseils;
wobei das Amboßelement mittels des Drahtseils von einer Offenstellung, in der die Amboßfläche wesentlich von dem Klammergehäuse beabstandet ist, in eine Gewebeannäherungsstellung bewegbar ist, in der die Amboßfläche zum Annähern an das Gewebe dicht an

dem Klammergehäuse steht und wobei das Amboßelement und das Klammergehäuse mittels des Drahtseils gemeinsam relativ zu der Klammerstoßeinrichtung auf die Handgriffbetätigungsvorrichtung zu aus der Gewebeannäherungsstellung in eine Schließstellung bewegbar sind, in der die Klammern durch die Klammerstoßeinrichtung von dem Klammergehäuse gegen die Amboßfläche gedrückt werden.

2. Klammergerät (10) nach Anspruch 1, wobei der Drahtseil-Mitnehmer weiterhin Verbindungsmittel zum selektiven Verbinden der Griffeinrichtung (54, 104) mit dem Drahtseil (24, 86) aufweist, wobei die Verbindungsmittel an dem Drahtseil-Mitnehmer (28, 88) aus einem abstehenden Stift (48, 96) zum Eingreifen der Griffeinrichtung bestehen.

3. Klammergerät (10) nach Anspruch 2, wobei die Griffeinrichtung aus einem ersten, schwenkbeweglich an dem Gehäuse (18, 82) befestigten Hebelarm (54, 104) und einem zweiten, schwenkbeweglich an dem ersten Hebelarm befestigten und selektiv mit dem Drahtseil-Mitnehmer kuppelbaren Hebelarm (58, 100) besteht, wobei der zweite Hebelarm einen Schlitz (50, 98) aufweist, der in Eingriff mit dem abstehenden Stift (48, 96) des Drahtseil-Mitnehmers bringbar ist.

4. Klammergerät (10) nach Anspruch 3, wobei in dem Gehäuse (18, 82) verschiebbare Rampenmittel (64, 108) angeordnet sind, die mit dem zweiten Hebelarm (58, 100) zusammenwirken, um den Schlitz (50, 98) des zweiten Hebelarms der Griffeinrichtung (54, 58, 100, 104) mit dem abstehenden Stift (48, 96) des Drahtseil-Mitnehmers (28, 88) in Eingriff zu bringen.

5. Klammergerät (10) nach einem der vorhergehenden Ansprüche, wobei das Statikelement aus einer Vielzahl von einzelnen, miteinander verbundenen, zylindrischen Wirbelsäulensegmenten (74, 85) besteht, die jeweils teilkugelförmig konkave und konvexe Enden (78) sowie einen sich zentrisch erstreckenden Hohlraum (76) aufweisen, durch den sich das Drahtseil hindurch erstreckt.

6. Klammergerät (10) nach einem der vorhergehenden Ansprüche, wobei die Handgriffbetätigungsvorrichtung (12, 80) eine Gewebespalteinstelleinrichtung aufweist, die mit dem Drahtseil-Mitnehmer (28, 88) wirkverbunden ist, um selektiv den Abstand zwischen der Amboßfläche und dem Klammergehäuse (130, 196) einzustellen.

7. Klammergerät (10) nach Anspruch 6, wobei die Gewebespalteinstelleinrichtung einen drehbaren Knopf (42) aufweist, der drehbar mit dem Gehäuse (18) der Handgriffbetätigungsvorrichtung(12) verbunden sowie mit dem Drahtseil-Mitnehmer 28 derart wirkverbunden ist, daß durch Rotation des drehbaren Knopfes der Drahtseil-Mitnehmer und das Drahtseil (24) bewegt werden sowie gleichzeitig das Amboßelement (132) in Richtung des Klammergehäuses (130) bewegt wird.

8. Klammergerät (10) nach Anspruch 6, wobei die Gewebespalteinstelleinrichtung einen drehbaren, an dem Gehäuse (82) der Handgriffbetätigungsvorrichtung (80) befestigten Knopf (120) aufweist, der ein zentrisches, sich axial erstreckendes Innengewinde und eine in dieses eingreifende Gewindestange (118) aufweist, wobei die Gewindestange mit dem Drahtseil-Mitnehmer (88) verbunden ist, wobei die Gewindestange nicht rotiert, sondern sich axial zu dem Innengewinde bewegt, so daß durch Rotation des drehbaren Knopfes die Gewindestange, der Drahtseil-Mitnehmer und das Drahtseil (86) bewegt werden sowie gleichzeitig das Amboßelement (186) in Richtung des Klammergehäuses (196) bewegt wird.

9. Klammergerät (10) nach einem der vorhergehenden Ansprüche, wobei die Klammerschließvorrichtung (14, 15) an dem Amboßelement einen Amboßschaft (134, 192) aufweist, wobei der Amboßschaft verschiebbar mit der Klammerstoßeinrichtung (166, 206) verbunden ist, und wobei das Klammergehäuse (130, 196) verschiebbar mit der Klammerstoßeinrichtung verbunden ist, so daß sich das Klammergehäuserelativ zu der Klammerstoßeinrichtung um einen Abstand bewegt, der ausreicht, um Klammern von dem Klammergehäuse auszustoßen und die Klammern an der Amboßfläche zu formen.

10. Klammergerät (10) nach Anspruch 9, wobei ein erstes Federvorspannelement (142, 208) zum Vorspannen des Amboßelementes (132, 188) gegen das Klammergehäuse (130, 196) sowie ein zweites Federvorspannelement (158, 210) zum Vorspannen des Klammergehäuses und des Amboßelementes gegen die Klammerstoßeinrichtung (166, 200) vorgesehen sind.

11. Klammergerät (10) nach Anspruch 10, wobei das erste Federvorspannelement (142,

208) eine Federkraft besitzt, die geringer als die Federkraft des zweiten Federvorspannelementes (158, 210) ist.

12. Klammergerät (10) nach Anspruch 11, wobei das erste Federvorspannelement (142, 208) eine Federkraft mit einer derartigen Relation zu der Federkraft des zweiten Federvorspannelementes (158, 210) aufweist, daß sich das Amboßelement (132, 188) relativ zu dem Klammergehäuse (130, 196) bewegt, und dann durch Überwindung des ersten Federvorspannelementes sich das Amboßelement und das Klammergehäuse relativ zu der Klammerstoßeinrichtung (166, 200) gegen das zweite Federvorspannelement bewegen.

13. Klammergerät (10) nach einem der Ansprüche 10 bis 12, wobei ein Amboßschaftaufnahmeelement (140) zum selektiven Einstellen des Abstandes zwischen der Amboßfläche und dem Klammergehäuse (130) vorgesehen ist, wobei das Amboßschaftaufnahmeelement verschiebbar mit der Klammerstoßeinrichtung (166) verbunden ist und den Amboßschaft (134) verschiebbar aufnimmt.

14. Klammergerät (10) nach Anspruch 13, wobei ein drittes Federvorspannelement (156) zum Vorspannen des Amboßschaftaufnahmeelementes (140) gegen das Klammergehäuse (130) vorgesehen ist, wobei das erste Federvorspannelement (142) das Amboßelement (132) gegen das Amboßschaftaufnahmeelement (140) vorspannt, und wobei das zweite Federvorspannelement (158) das Amboßelement (132), das Amboßschaftaufnahmeelement sowie das Klammergehäuse (130) gegen die Klammerstoßeinrichtung (166) vorspannt.

15. Klammergerät (10) nach Anspruch 14, wobei das erste Federvorspannelement (142) eine Federkraft besitzt, die geringer als die Federkraft des dritten Vorspannelementes (156) ist, und wobei das dritte Vorspannelement eine Federkraft aufweist, die geringer als die Federkraft des zweiten Federvorspannelementes (158) ist.

16. Klammergerät (10) nach Anspruch 15, wobei die relativen Federkräfte des ersten, zweiten und dritten Federvorspannelementes (142, 158, 156) derart gewählt sind, daß sich das Amboßelement (132) relativ zu dem Amboßschaftaufnahmeelement (140) bewegt, bis das erste Federvorspannelement überwunden ist, sich dann das Amboßelement und das Klammergehäuse (30) relativ zu der Klammerstoßeinrichtung bewegen, bis das dritte Federvorspannelement überwunden ist, und sich dann das Amboßelement, das Klammergehäuse sowie das Amboßschaftaufnahmeelementrelativ zu der Klammerstoßeinrichtung gegen das zweite Federvorspannelement bewegen.

17. Klammergerät (10) nach Anspruch 1, wobei die Klammerschließvorrichtung (14, 15) weiterhin aufweist:
einen verschiebbar in die Klammerstoßeinrichtung (166) eingreifenden Amboßschaft (134) an dem Amboßelement (132);
ein erstes Federvorspannelement (142, 156) zum Vorspannen des Amboßelementes gegen das Klammergehäuse (130); und
ein zweites Federvorspannelement (158) zum Vorspannen des Klammergehäuses gegen die Klammerstoßeinrichtung.

18. Klammergerät (10) nach Anspruch 17, wobei ein Amboßschaftaufnahmeelement (140) bezüglich der Klammerstoßeinrichtung (166) verschiebbar angeordnet ist, welches den Amboßschaft verschiebbar aufnimmt; wobei das erste Federvorspannelement eine erste, das Amboßelement (132) gegen das Amboßschaftaufnahmeelement (140) vorspannende Feder (142) und eine zweite, das Amboßschaftaufnahmeelement gegen das Klammergehäuse vorspannende Feder (156) aufweist; und wobei das zweite Federvorspannelement (158) das Amboßschaftaufnahmeelement und das Klammergehäuse (130) gegen die Klammerstoßeinrichtung (166) vorspannt.

19. Handgriffbetätigungsvorrichtung zur Verwendung mit einem flexiblen chirurgischen Klammergerät, bestehend aus:
einem einen inneren Hohlraum (30, 90) umschließenden Gehäuse (18, 82);
einem innerhalb des Hohlraums bewegbaren Drahtseil-Mitnehmer (28, 88), der Drahtseil-Verbindungsmittel zum Verbinden des Drahtseil-Mitnehmers mit einer Länge eines flexiblen Drahtseils (24, 86) aufweist; einem von dem Drahtseil-Mitnehmer abstehenden Stift (48, 96);
einem ersten, schwenkbeweglich an dem Gehäuse befestigten Hebelarm (54, 104);
einem zweiten, schwenkbeweglich an dem ersten Hebelarm befestigten Hebelarm (58, 100) sowie einem Schlitz (50, 98) an dem zweiten Hebelarm, wobei der Hebelarm über den Schlitz mit dem abstehenden Stift des Drahtseil-Mitnehmers wirkverbindbar ist; und

Gewebeannäherungsmitteln (42, 120) an dem Gehäuse, die mit dem Drahtseil-Mitnehmer wirkverbunden sind, um die Position des Drahtseil-Mitnehmers innerhalb des Hohlraums selektiv einzustellen; und
verschiebbaren Rampenmitteln (64, 108) in dem Gehäuse, die mit dem zweiten Hebelarm zusammenwirken, um den Schlitz des zweiten Hebelarms mit dem abstehenden Stift des Drahtseil-Mitnehmers in Eingriff zu bringen.

20. Klammerschließvorrichtung zur Verwendung mit einem flexiblen chirurgischen Klammergerät, bestehend aus:
einem Klammerpatronenaufnahmeelement (150, 198) zur Aufnahme einer Patrone (130, 196), die eine Reihe von Klammern und Klammertreibern (172) für die Klammern enthält;
einem Amboßelement (132, 186, 188), das eine Amboßfläche mit einer Reihe von Klammerformvertiefungen (182) aufweist;
einem Amboßschaft (134, 192) an dem Amboßelement; und einer Klammerstoßeinrichtung (186, 200), die einen sich nach vorne erstreckenden Kopf oder ein Ende zum Berühren der Klammertreiber aufweist, um die Klammertreiber gegen die Klammern in der Patrone zu drücken und dabei die Klammern gegen die Klammerformvertiefungen der Amboßfläche zu pressen, wenn sich das Klammerpatronenaufnahmeelement, das Amboßelement und der Amboßschaft rückwärts auf die Klammerstoßeinrichtung zu bewegen.

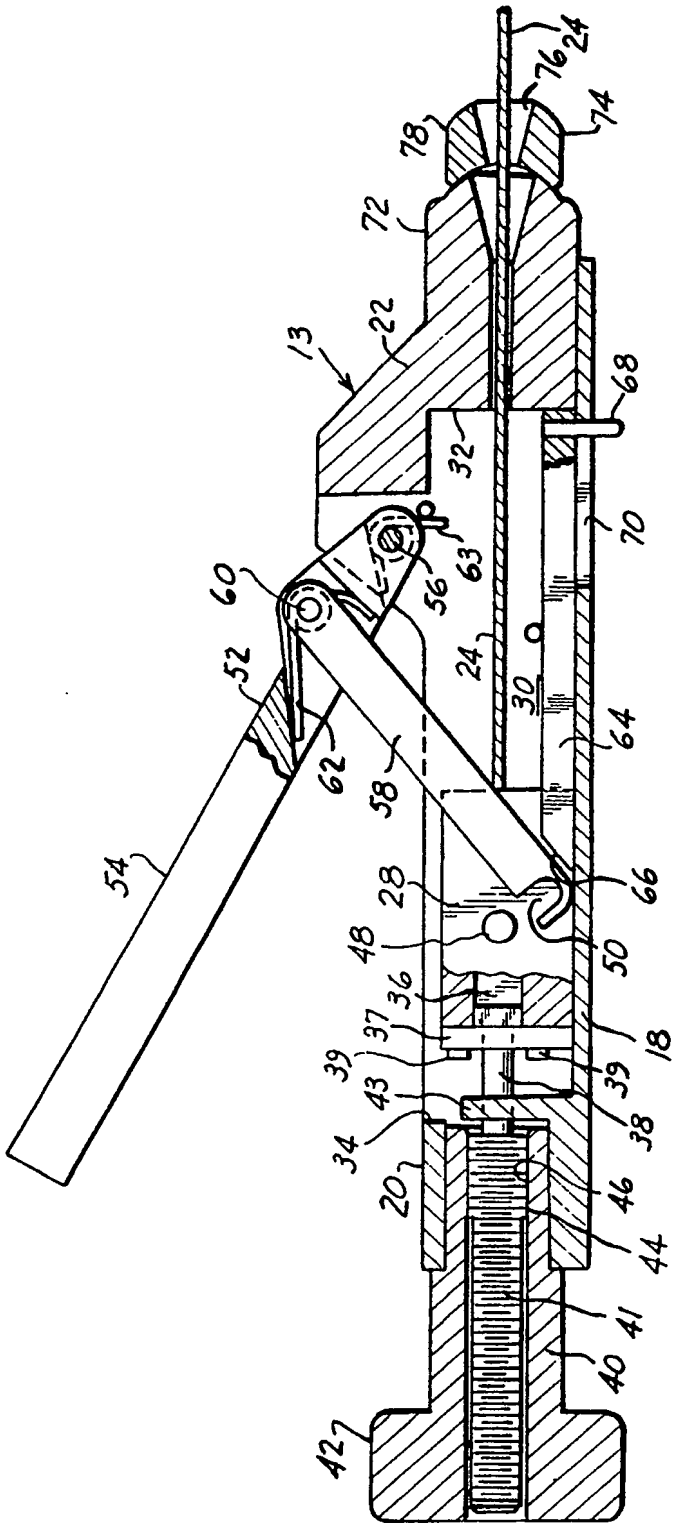
21. Vorrichtung nach Anspruch 20,
wobei ein erstes Federvorspannelement (142, 156, 208) zum Vorspannen des Amboßelementes (132, 186, 188) gegen das Klammerpatronenaufnahmeelement (150, 198) sowie ein zweites Federvorspannelement (156, 210) zum Vorspannen des Klammerpatronenaufnahmeelementes (150, 198) und des Amboßelementes gegen die Klammerstoßeinrichtung (166, 200) vorgesehen sind.

22. Vorrichtung nach Anspruch 21,
wobei ein Amboßschaftaufnahmeelement (140) zum selektiven Einstellen des Abstandes zwischen der Amboßfläche und einer in dem Klammerpatronenaufnahmeelement (150) gehaltenen Klammerpatrone (130) vorgesehen ist, wobei das Amboßschaftaufnahmeelement verschiebbar mit der Klammerstoßeinrichtung (166) verbunden ist und den Amboßschaft (134) verschiebbar aufnimmt.

23. Vorrichtung nach Anspruch 22,
wobei das erste Federvorspannelement eine erste Feder (142) zum Vorspannen des Amboßschaftaufnahmeelementes (140) gegen das Klammerpatronenaufnahmeelement (150) sowie eine zweite Feder (156) zum Vorspannen des Amboßelementes (132) gegen das Amboßschaftaufnahmeelement aufweist, und wobei das zweite Federvorspannelement (156) das Amboßelement (132), das Amboßschaftaufnahmeelement und das Klammerpatronenaufnahmeelement gegen die Klammerstoßeinrichtung (166) vorspannt.

24. Vorrichtung nach einem der Ansprüche 20 bis 23,
wobei eine Länge eines flexiblen Drahtseils (24, 86) mit einem seiner Enden mit dem Amboßelement (132, 186, 188) verbunden ist.

25. Vorrichtung nach Anspruch 24,
wobei die Länge des flexiblen Drahtseils (24) sich durch das Klammerpatronenaufnahmeelement (150) und durch die Klammerstoßeinrichtung (166) der Klammerschließvorrichtung hindurch erstreckt.


24
76
74
78
72
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32
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56
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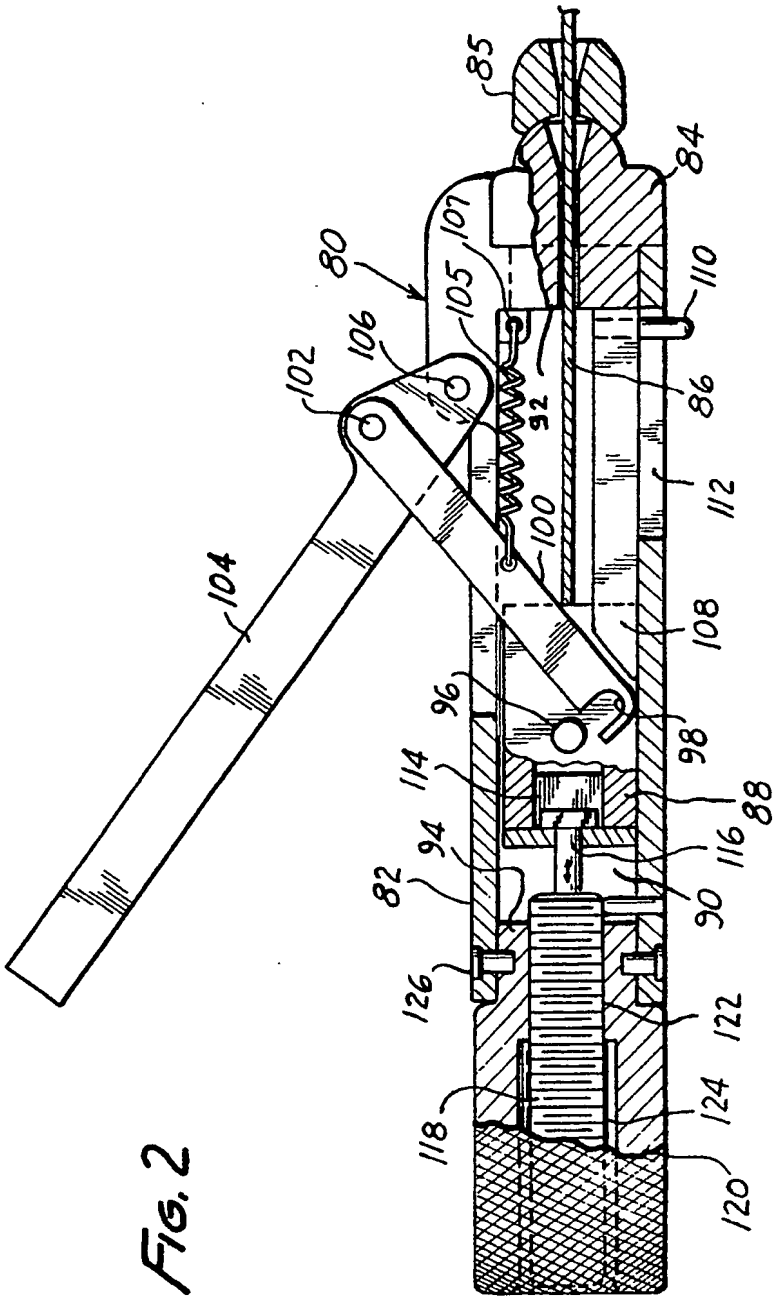
42

FIG. 1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106
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114
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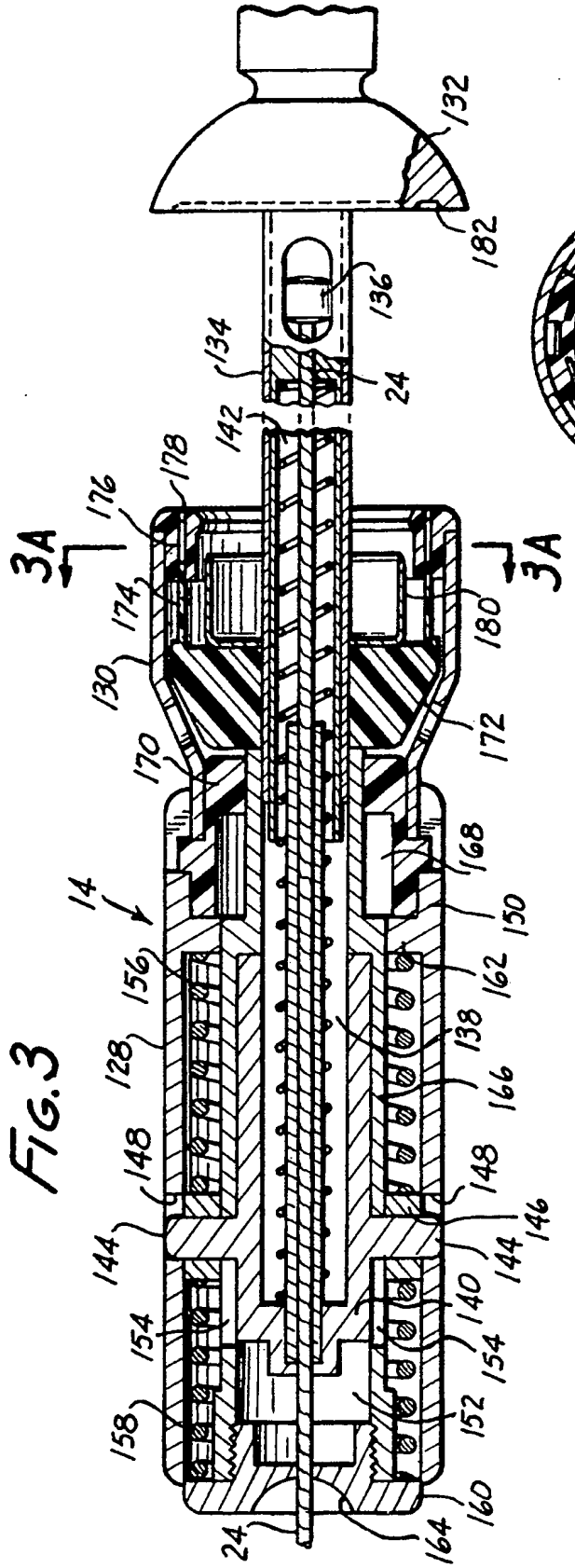
94
116
82
90
126
122
124
118
120

Fig. 2


132
182
136
134
24
142
178
176
3A
3A
174
180
130
172
170
168
14
150
156
162
128
138
166
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24

FIG. 3

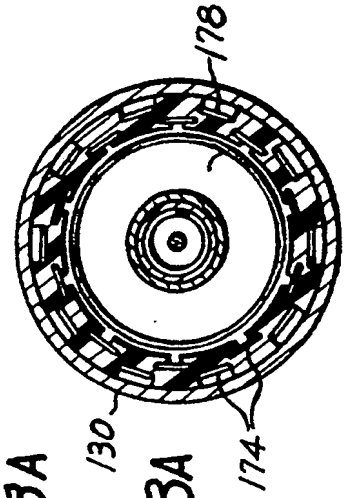
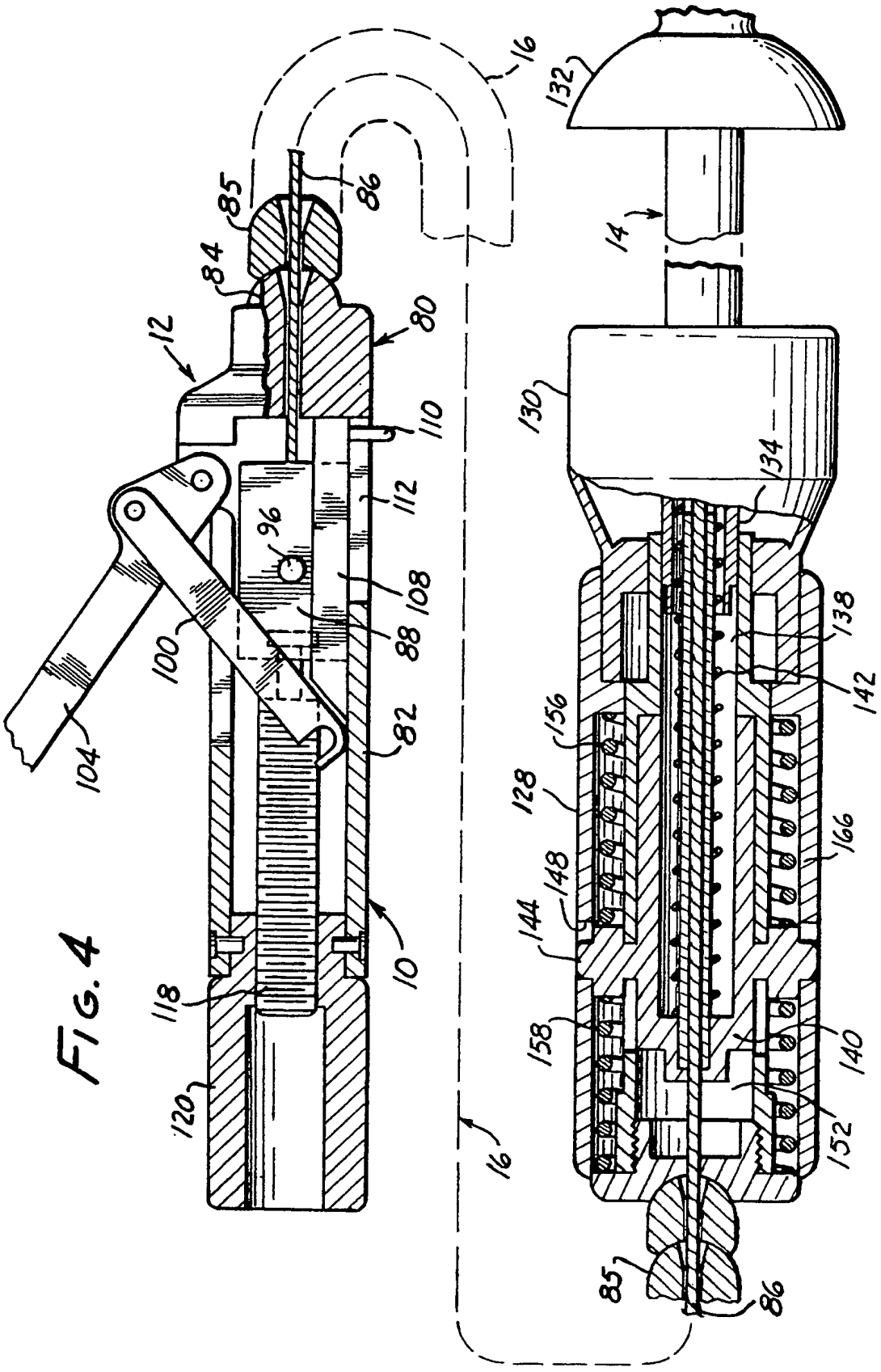

178
130
174

FIG. 3A


16
132
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86
14
84
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12
130
110
134
112
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108
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138
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142
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128
166
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144
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158
140
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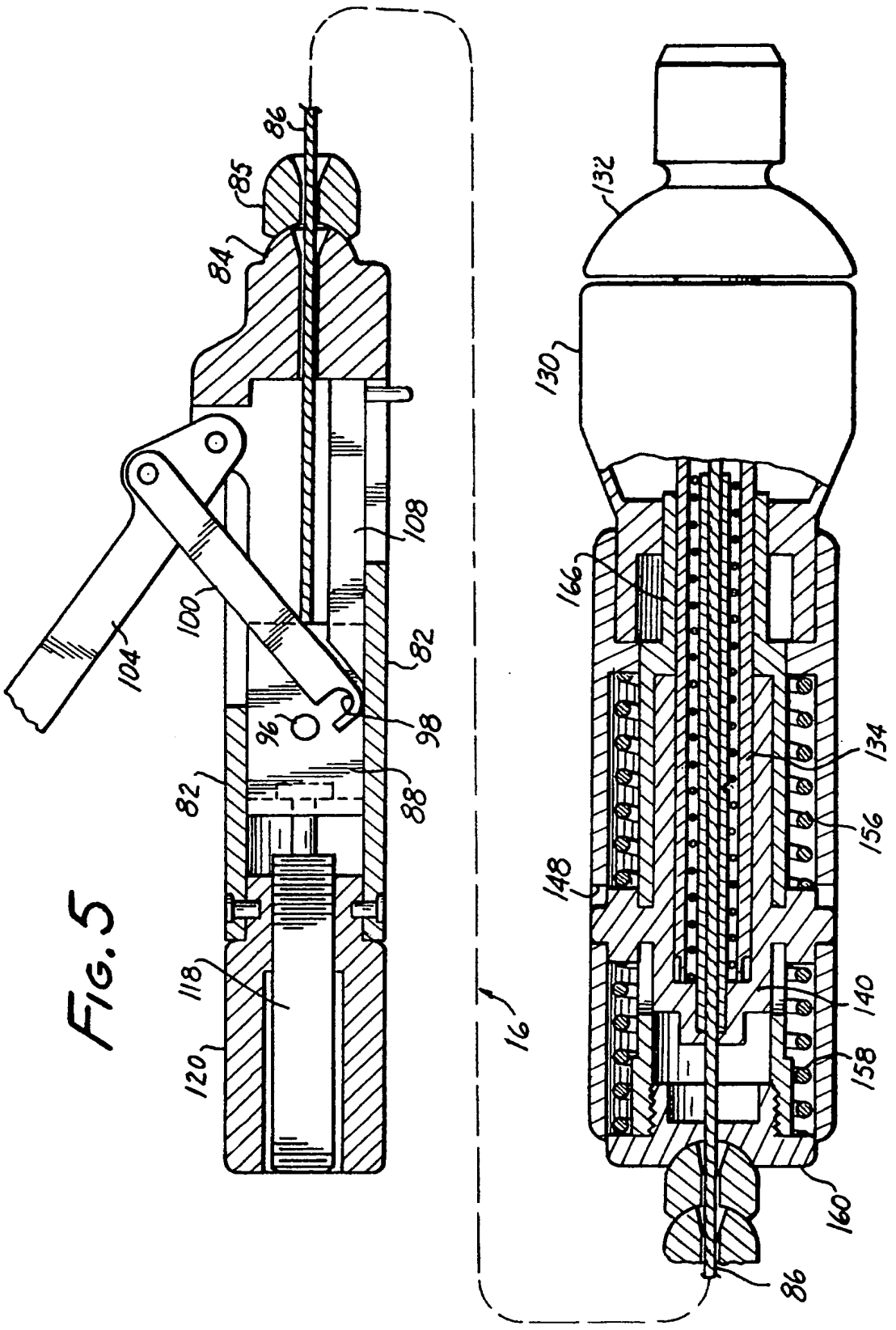
120
152
16
85
86

FIG. 4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85
84
108
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118
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132
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166
134
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140
158
160
86

FIG. 5

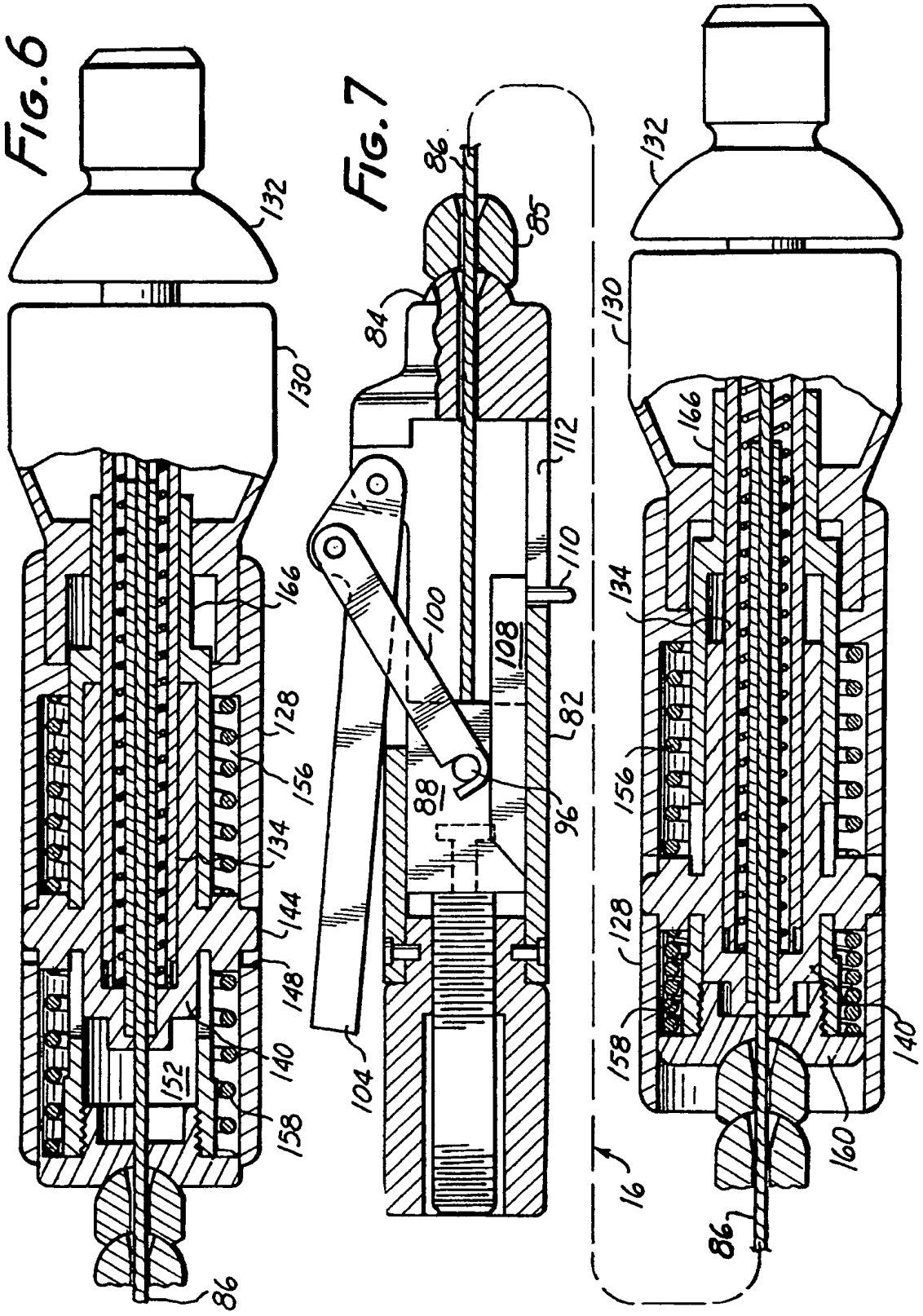
FIG.6
132
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166
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156
134
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148
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152
158
86
FIG.7
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112
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96
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132
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166
134
156
128
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140
160
16
86

FIG.8

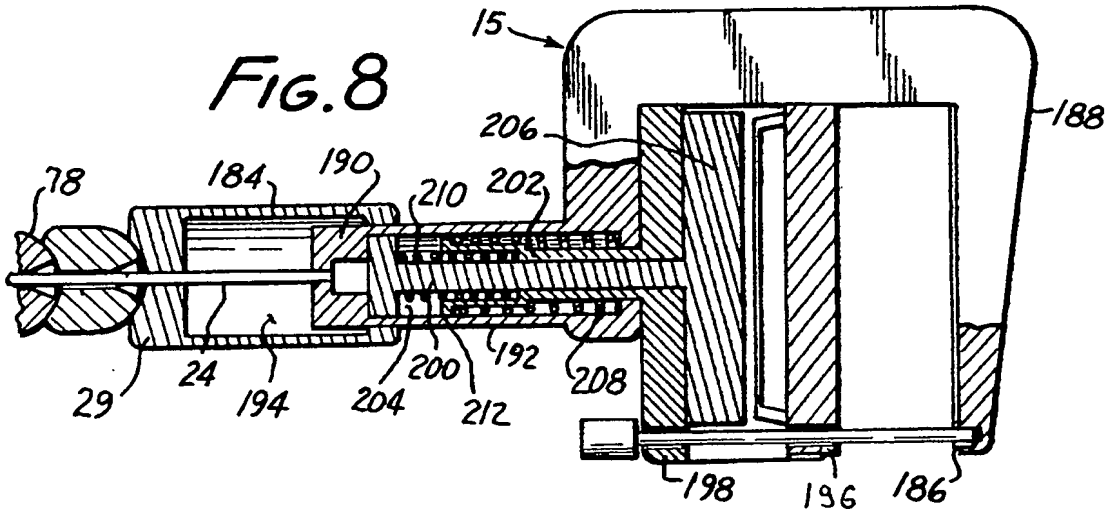

FIG.9

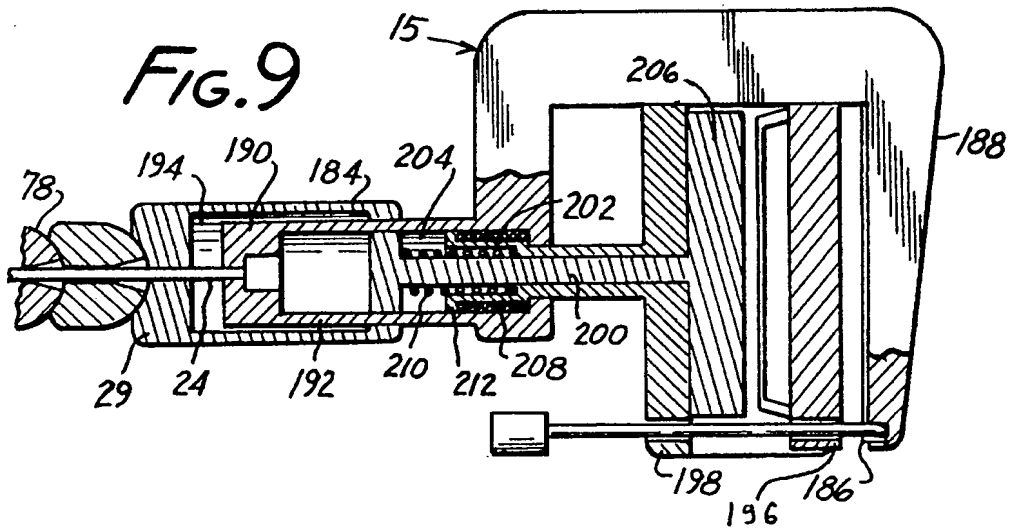

FIG.10